

VPA Permit Fact Sheet

This document gives pertinent information concerning the issuance of VPA Permit No. VPA01423. The permit regulates the land application of municipal wastewater generated at a sequencing batch reactor wastewater plant.

1. Facility Name and Address: Coles Point Wastewater Treatment Plant
2585 Coles Point Road
Hague, Va. 22469

Legal Name and Address of Owner: Westmoreland County
P.O. Box 1000
Montross, Va. 22520

2. Location of Pollution Management Activity: Coles Point , Virginia.
2585 Coles Point Road
Hague, Va. 22469

3. Facility Contact: Norm Risavi, County Administrator
(804) 493-0113

4. Permit Drafted By: Mosca - PRO/KO Date: July 3, 2003
Site Inspection: Mosca - PRO/KO Date: September 25, 2002
Application Checklist: Mosca Date: November 16, 2002

Reviewed By: Curt Linderman, PRO (8-11-03, 8-29-03, 9-8-03), James Golden, PRO (7-7-03), Allan Brockenbrough, OWPS (8-7-03)

5. Permit Characterization: SIC Code: 4952

Permit Type	Facility	Permit Action
<input type="checkbox"/> Existing Facility	<input checked="" type="checkbox"/> Municipal	<input checked="" type="checkbox"/> Issuance
<input checked="" type="checkbox"/> Proposed Facility	<input type="checkbox"/> Industrial	<input type="checkbox"/> Reissuance
<input checked="" type="checkbox"/> Land Application:	<input type="checkbox"/> Conc. Animal Feeding	<input type="checkbox"/> Modification
<input type="checkbox"/> Frequent	<input type="checkbox"/> Inten. Animal Feed	<input type="checkbox"/> NDC Conversion
<input checked="" type="checkbox"/> Infrequent	<input type="checkbox"/> Other Animal	<input type="checkbox"/> Inter. Authorization
<input checked="" type="checkbox"/> Land App. Wastewater	<input type="checkbox"/> Aquaculture	<input type="checkbox"/> Enforcement Action
<input type="checkbox"/> Other:		<input type="checkbox"/> Revoke and Reissue

6. Statutory or Regulatory Basis for Special Conditions and Monitoring Requirements:

- ☒ State Water Control Law
- ☒ 9 VAC VR 680-14-01 Permit Regulation
- ☒ Water Quality Standards (Surface and Groundwater Monitoring)
- ☒ Agency Guidance - VPA Manual

7. Application Information:

Application Submitted By:	Norm Risavi, County Administrator		
Additional Information:	Requested:	Received:	5-29-02
	6-27-02		7-24-02
	8-7-02		9-3-02
	11-22-02		2-5-03
	3-21-03		4-11-03

Application Complete Date: Administratively complete 9-16-02, Technically complete July 10, 2003 (approval of NMP)

8. Pollution Management Activity Description:

The pollutant management activities involve the land application of wastewater from a sequencing batch reactor. The average estimated daily flow projected out 20 years is 81,430 gpd for the summer, 49,285 gpd for the winter months. The treated wastewater will be sprayed onto property at agronomic rates in Coles Point consisting of 50.4 acres with a reserve area of 12.6 acres. Reed Canary grass will be grown as a crop. Fixed irrigation will be utilized; Rainbird 46H spray heads will be placed at equilateral distances of 80 ft. Bolted steel tanks, 3 MG each, have been substituted for lagoons originally proposed for wastewater storage. Because of the impermeability of the construction, groundwater wells have not been required around the wastewater storage area. Six groundwater wells have been installed at the spray irrigation site and six sets of background analyses have been collected to date.

9. Licensed Operator Requirements: Class III

10. Facility Reliability Class: Class I

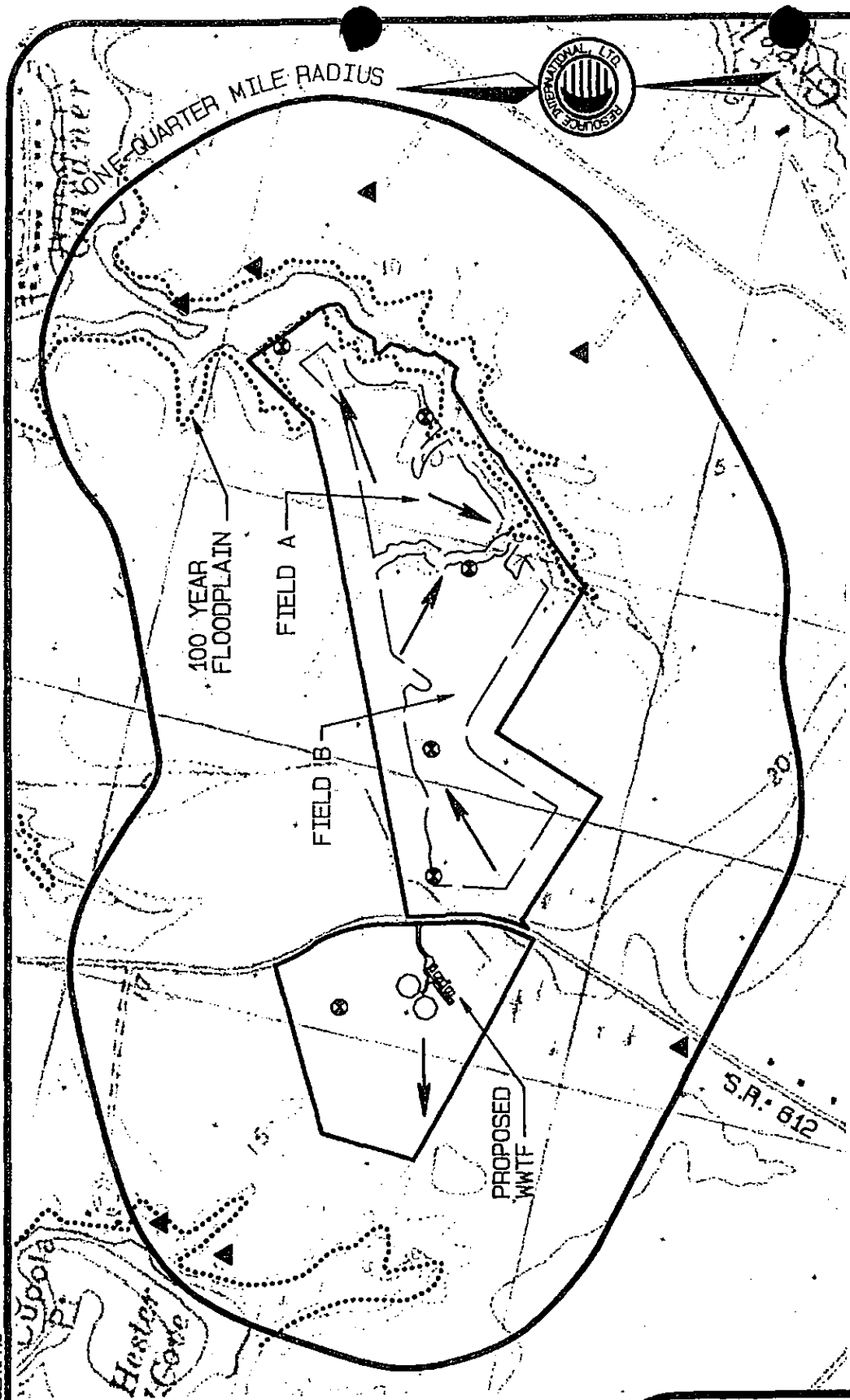
11. Facility Location: Coles Point, Va.

12. Permit Special Conditions: Rationale

- B.1. No-discharge provision. 9 VAC 25-32-30 establishes a no-discharge status for VPA permits except in the case of a storm event greater than the 25 year-24 hour storm event.
- B.2. Materials Handling/Storage. 9 VAC 25-32-30 prohibits the discharge of any wastes into State waters unless authorized by permit. State Water Control Law § 62.1-44.18:2 authorizes the Board to prohibit any waste discharge which would threaten public health or safety, interfere with or be incompatible with treatment works or water use. Section 301 of the Clean Water Act prohibits the discharge of any pollutant unless it complies with specific sections of the Act.
- B.3. Indirect Dischargers. Required by the VPDES permit regulation, 9VAC 25-31-200 B 1 for all POTWs and PVOTWs that receive waste from someone other than the owner of the treatment works. This requirement is for the owner to notify DEQ in the event waste is accepted from any other source than the owner.
- B.4. Effluent restricted to sites in Attachment A and maintenance of cover crop to application areas This condition restricts the spray irrigation to those sites identified in the application and was modified from the permit manual boilerplate to include a clarification that the establishment of the cover crop shall be in conformance with the NMP. The maintenance of a cover crop to application areas is to avoid application to bare ground to prevent runoff. OWRM (now OWPS) Guidance memo 94-002. This condition is intended to prevent the application of effluent to bare ground. This condition is intended to prevent the application of effluent to bare ground.
- B.5. Operation and Maintenance Manual Requirement. 9 VAC 25-32-80 and 40 CFR 122.41(e) require proper operation and maintenance of the permitted facility. Compliance with an

H:\940240- 27\FIG2A.PRD

FIGURE 2A
MODIFIED VICINITY MAP
COLES POINT WASTEWATER
TREATMENT FACILITY
WESTMORELAND COUNTY, VIRGINIA



THE FOLLOWING FEATURES DO NOT
EXIST WITHIN THE SUBJECT AREA:

- PUBLIC WATER SUPPLY (S)
- SINKHOLES
- UNDERGROUND AND/OR SURFACE MINES
- MINE POOL (OR OTHER) SURFACE WATER DISCHARGE POINTS
- MINING SPOIL PILES AND MINE DUMPS
- QUARRY (S)
- SAND AND GRAVEL PITS
- GAS AND OIL WELLS
- DIVERSION DITCH(S)
- AGRICULTURAL DRAINAGE DITCH(S)
- LANDFILLS OR DUMPS
- OTHER UNLINED IMPOUNDMENTS
- INJECTION WELLS
- ROCK OUTCROPS

SOURCE: 7.5 MINUTE SERIES QUADRANGLES
U.S.G.S. KINSALE AND MACHODOC
SCALE: 1" = 1,000'

LEGEND

- PROPERTY BOUNDARY
- FIELD BOUNDARY
- 100 YEAR FLOODPLAIN
- GROUNDWATER FLOW DIRECTION
- GROUNDWATER MONITORING WELLS
- APPROXIMATE LOCATION OF DWELLINGS WITH WELLS AND SEPTIC SYSTEMS

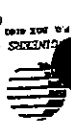
NOTE: FIELD "A" CONTAINS
SECTIONS 3A AND 3B.
FIELD "B" CONTAINS
SECTIONS 1A, 1B, 2A AND 2B.



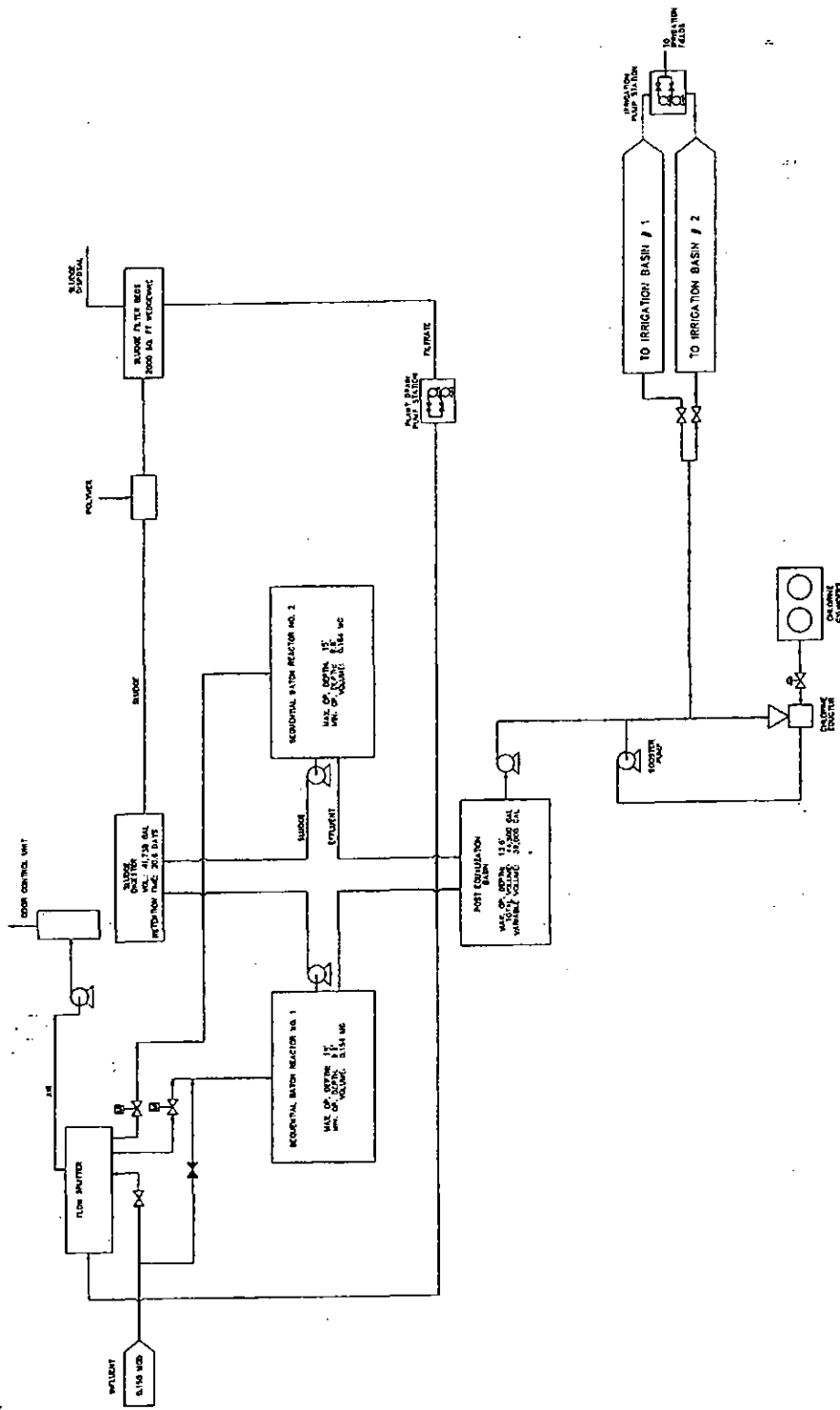
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VPA Permit No. VPA0142
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OVERALL PROCESS FLOW DIAGRAM

- LEGEND:
- PUMP
 - VALVE, NORMALLY OPEN
 - VALVE, NORMALLY CLOSED
 - CHECK VALVE
 - PRESSURE INDICATOR
 - CONTROL VALVE
 - MOTORIZED VALVE

approved O&M manual ensures this. Section 401 of the Clean Water Act requires the permittee to provide opportunity for the State to review the proposed operations of the facility. Clarification to the permit manual boilerplate was made for approval of the manual prior to start-up of operations. The special condition for the development of a sludge management plan was added as a sub-condition to this special condition for the O&M manual. Sludge Management Plan. VPDES Permit Regulation 9 VAC 25-31-100 J, 220 B 2, and 420 through 720, and 40 CFR Part 503 require all sewage treatment plants to submit information on their sludge use and disposal practices and to meet specified standards for sludge use and disposal. Technical requirements are derived from the Department of Health's Biosolids Use Regulations, 12 VAC 5-585-10 et seq.

- B.6. Nutrient Management Plan Update no later than every 3 years and Nutrient Management Plan (NMP) included in O&M. These requirements are based on the VPA Permit Manual, current guidance, and DCR recommendations. The nutrient management plan is to be included as part of the O&M manual and approved in accordance with the O&M manual approval process. However, any increase in the amount of land application area cited within or outside of the NMP must go through a public participation process, i.e., a major modification, which includes a permit fee.
- B.7. Soil Moisture Monitoring Plan. This requirement is based on the VPA Permit Manual, current guidance, and DCR recommendations.
- B.8. Soil moisture sensor readings. This requirement is based on the VPA Permit Manual, current guidance, and DCR recommendations.
- B.9. Harvest of Reed Canary Grass in accordance with O&M manual--OWRM (now OWPS) Guidance memo 93-023.
- B.10. Cation Imbalance Plan. This requirement is based on the VPA Permit Manual, and current guidance.
- B.11. Irrigation Scheduling Requirement: This requirement is based on the VPA Permit Manual and current guidance.
- B.12. Reserve Area: The requirement to have a reserve area equal to 25% of the size of the sprayfield that can be placed into service within 30 days is based on the SCAT regulation and current DEQ guidance.
- B.13. Winter application: This requirement is based on the SCAT regulation and current guidance.
- B.14. Effluent not to be applied at rates that exceed the approved SMMP and the NMP. This requirement is based on the VPA Permit Manual, current guidance, and DCR guidance.
- B.15. Buffer zones. This requirement is based on the VPA Permit Manual and current guidance.
- B.16. Requirement for operator. This requirement is based on the VPA Permit Manual, and current guidance.
- B.17. Operational limitations. This requirement is based on the VPA Permit Manual, current guidance, and DCR guidance.
- B.18. 30 day separation from application and crop utilization. This requirement is based on the VPA Permit Manual and current guidance.

- B.19. Crops not to be consumed by man after irrigation. This requirement is based on the VPA Permit Manual and current guidance
- B.20. Monthly summary report. Required by VPA manual and current guidance.
- B.21. Annual Summary Report. Required by VPA manual and current guidance.
- B.22. Freeboard requirement. The 2 ft. freeboard is required by the VPA manual.
- B.23. Total PAN Restriction. VPA manual restricts the applied PAN from all sources not to exceed the allowable crop nitrogen uptake. Use of this system is expected to be conservative for the spray irrigation of wastewater. This condition was modified for the documentation of total phosphorus and total potassium from the wastewater and all additional source.
- B.24. Use of Reserve Area. A condition whereby DEQ is notified when influent flows to the treatment facility approach the design flow is required by the VPDES Permit Regulation, 9 VAC 25-31-200 B for all POTW and PVOTW permits. This condition was adapted from the VPDES permit manual for this VPA permit because of the need for notification of DEQ if flows became a problem at the site. The use of the reserve site for three consecutive months was identified as the prompt for action.
- B.25. Requirement for CTC/CTO. Required by Code of Virginia at 62.1-44.19; Sewerage Regulations 9 VAC 25-60-120 and 280, and VPDES Permit Regulation, 9 VAC 25-31-190 E.
- B.26. Facilities Closure Plan upon termination of activities. OWRM (now OWPS) Guidance memo 94-002.
- B.27. Endangered or Threatened Species: This requirement is based on both the VPDES and the VPA Permit Manuals and current guidance. Bald eagle nests are located at the site.
- B.28. New Dischargers which are permitted from Form 2D: The permit limitations are based on assumed effluent quality characteristics when application Form 2D is used. These assumptions (and the permit basis) can only be validated with actual effluent data. The submission of actual data is required in the application form instructions. A new series of site life calculations is also required.

Monitoring Requirements:

Wastewater monitoring is necessary at a facility with land application of wastewater, to know the nutrient value of the wastewater being applied to the field crop. If the nutrient value of the wastewater is less than that required by the crop, then pollutants will not migrate off-site. The wastewater parameters selected for monitoring were those detailed in DEQ Guidance Memo 94-002 Regional Directors' Authorization to Process VPA Permits for Land Application of Municipal Wastewater. Alkalinity was added to the monitoring list in accordance with the VPA Permit Manual. The metals form of Total Recoverable in wastewater, groundwater and soils monitoring was chosen for comparability.

Soil monitoring is necessary to ensure the viability of the land application system. The parameters chosen for monitoring are those recommended by OWRM (now OWPS) Guidance memo 94-002 for a facility land applying wastewater. Ammonia nitrogen is suggested in the VPA manual and not in 94-002, but added for completeness and comparability to other data sets for the other media.

Groundwater Monitoring is required at the application site. Piedmont Regional Office policy requires groundwater monitoring at all land application sites. The VPA draft technical manual also recommends groundwater monitoring at wastewater application sites. The parameters selected are

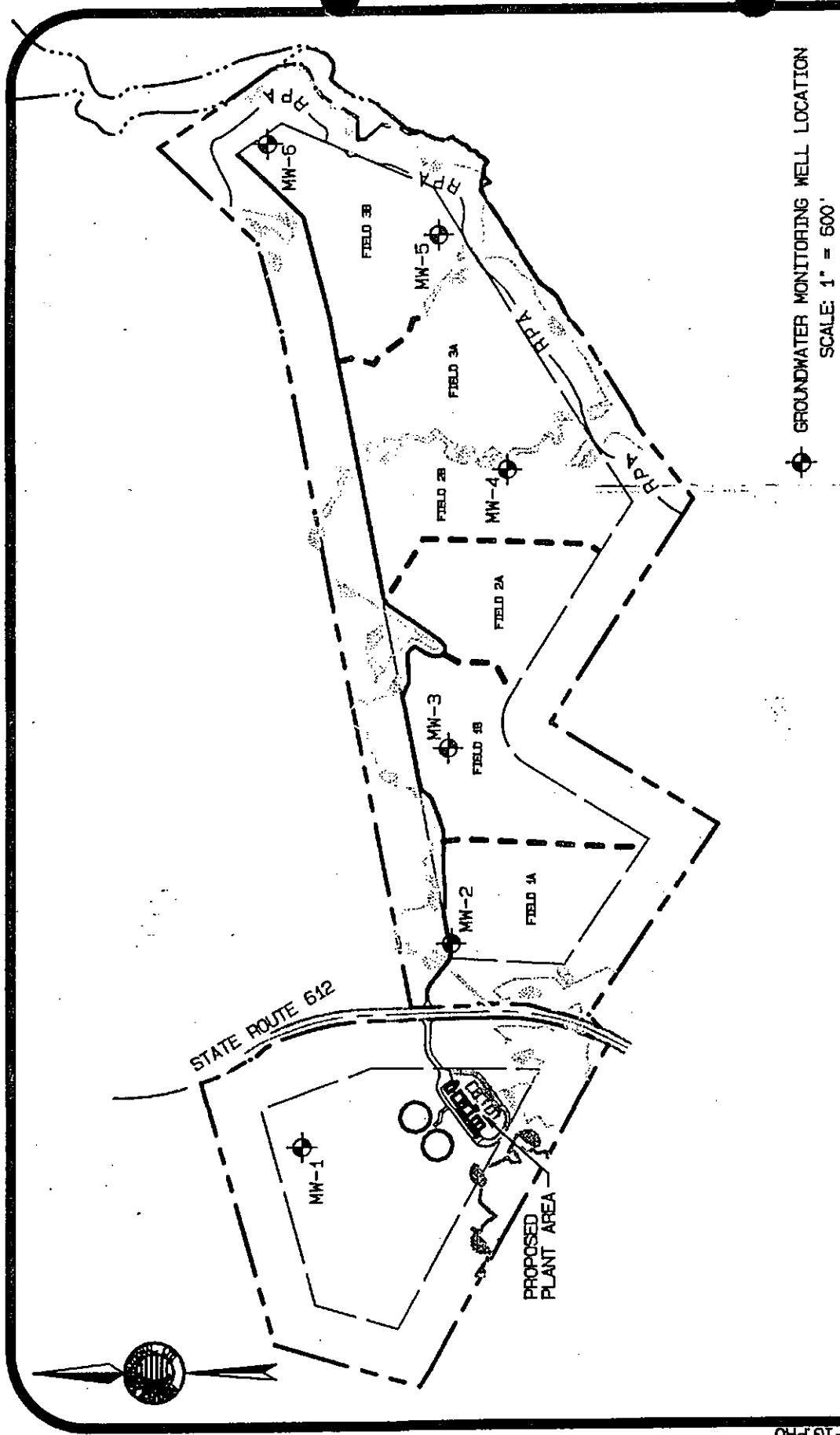


FIGURE 1
GROUNDWATER MONITORING WELL LOCATION MAP
COLES POINT WASTEWATER TREATMENT FACILITY
WESTMORELAND COUNTY, VIRGINIA

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[illegible]

NOTE: THE EOLZ BOARDS ON THIS SHEET WERE MADE BY EARTH TECH, INC.

[illegible]

SOILS INDEX

10 - LOOSE LOAM
11 - SANDY LOAM
12 - SANDY LOAM
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those recommended by OWRM (now OWPS) Guidance memo 94-002 for a facility land applying wastewater; the same parameters that are recommended in the SCAT regulations. Manganese was added to the list of parameters to be monitored (to address corresponding GW standards from 9 VAC 25-260-210).

Surfacewater Monitoring is required to ensure that no runoff occurs from the site. The VPA manual recommends surface water monitoring at land application sites. The parameters included on the monitoring list are selected from the VPA permit manual. Sulfate is added to the list as high levels may be seen from commercial fertilizers, and may help to pinpoint a source of pollutants seen in the monitoring.

Public Notice: The draft permit will be public noticed in the Westmoreland News. Public Notice Information required by 9 VAC 25-31-280 B:

Comment period: Date of first publication: September 17, 2003 End date: October 20, 2003

All pertinent information is on file and may be inspected and copied by contacting Denise M. Mosca at Virginia DEQ Kilmarnock Office, P.O. Box 669, Kilmarnock, Va. 22482. (804) 435-3181 e-mail address: dmmosca@deq.state.va.us

Persons may comment in writing or by e-mail to the DEQ on the proposed issuance of the permit and may request a public hearing during the comment period. Written or email comments shall include the name, address and telephone number of the writer, and shall contain a complete, concise statement of the factual basis for comments. Only those comments received within this period will be considered. The DEQ may decide to hold a public hearing if public response is significant. Requests for public hearings shall state the reason why a hearing is requested, the nature of the issues proposed to be raised in the public hearing and a brief explanation of how the requester's interests would be directly and adversely affected by the proposed permit action.

Following the comment period, the Board will make a determination regarding the proposed issuance. This determination will be come effective, unless the DEQ grants a public hearing. Due notice of any public hearing will be given.

Attachments: Topo map/Site Diagram
Flow Diagram
Groundwater Monitoring Well Location Map
Facility Location Map

Permit Processing Change Sheet – Monitoring Requirements					
Monitoring	Parameter Changed	Requirement Changed From	Requirement Changed To	Rationale	Initials and Date
Permit Processing Changes - Special Conditions					
<p>1.A. 1.Wastewater monitoring. The TKN analysis requirement prior to the storage ponds was eliminated as it is sufficiently addressed through the TKN monitoring after storage.</p> <p>1.A.1. Wastewater monitoring. The sample type was clarified to reflect the size of the WWTP from the recommendation in the VPDES permit manual (changed 24HC to 8HC).</p> <p>1.A.1. The overall design flow of the land treatment system is as specified in the approved and current NMP (changed from "is to be determined.")</p> <p>1.A.2. The footnote "d" was made consistent with preceding page.</p> <p>1.A.4. p. 4 Land Application monitoring. The footnote on the PAN parameter should be "b," not c. Reference to the special condition was verified. For the phosphorus parameter, reference to a special condition, implying a limit, was dropped, and denoted "NL." For the potassium parameter, reference to a special condition, implying a limit, was dropped, and denoted "NL." In item a, second line, a word seemed to be missing. The words "and the" were deleted as an artifact.</p> <p>1.A.4. Hydraulic Conductivity parameter – Resource correctly pointed out that a composite sample for Hydraulic conductivity is not appropriate. The requirement for composite samples is replaced with a footnote stating that samples shall be taken in each field.</p> <p>1.A.4.a. Hydraulic Conductivity footnote clarified for sampling to be initiated at the most restrictive subsoil layer.</p> <p>1.B.4. This condition was clarified to prevent the application of effluent to bare ground.</p> <p>1.B.5. A special condition to maintain a complete and healthy crop was deleted and the word "maintain" was added to a similar special condition above it to establish a complete and healthy crop.</p> <p>1.B.6. (formerly), now I.B.5. O&M manual condition. The QL issue was addressed by an addition to special condition No. 6, "The O&M manual shall include a quality assurance plan which specifically addresses sampling and laboratory analyses. This plan must include a sampling protocol, holding times, laboratory methods and quantification limits." It was also clarified that the most current approved version of the O&M and NMP shall supercede all previously approved editions.</p> <p>1.B.7. (formerly), now I.B.6. NMP condition. This condition was clarified per owner concerns to specify that the NMP may be re-evaluated earlier than the three year expiration, and that the approval is to be performed as an O&M manual approval. Further clarification in the fact sheet is made that any increase in the amount of land application area, cited either within or outside of the NMP, must go through the public participation process, i.e., a major modification that includes a permit fee.</p> <p>1.B.13. (formerly), now I.B.12. Reserve area in service within 30 days. Language was deleted about the 30 days beginning with the notification to DEQ under Part II.F.1. Instead, I.B.21.h., (formerly), now I.B.20.h. (monthly summary report) now contains a requirement for a list to specify when groundcover was initiated, and dates of effluent application. The original requirement for a spray head utilization summary (see below) was deleted.</p> <p>B.1.21.f., (formerly), now I.B.20.f. Freeboard measurements may be documented on Attachment D.10.</p> <p>B.1.21.h., (formerly), now I.B.20.h. Requirement for a summary of spray head utilization. This is not appropriate for the particular irrigation system at Coles Point as it would be for a traveling gun type system, so the requirement was deleted. The documentation of land application rates is required elsewhere in the permit.</p> <p>B1.29., (formerly), now deleted. End gun spray equipment operation condition and fact sheet justification (Page 4 of 6). This is also not appropriate for the particular irrigation system at Coles Point as it would be for a traveling gun type system, so the requirement was deleted. The documentation of land application rates is required elsewhere in the permit.</p> <p>Attachment D.3. Storage Tank Freeboard. Resource pointed out this should be shown as 2 ft. minimum rather than 2 ft. maximum. This was corrected.</p> <p>Fact sheet page 5 of 6 – The public notice language includes in the last paragraph a statement referring to the permit action as reissuance; Resource said it should be issuance instead. This is correct as well.</p> <p>The metals forms on the attachments have been specified as total recoverable.</p> <p>Attachment D.6. The sample type for hydraulic conductivity has been corrected to match Part 1.A.</p> <p>Attachment D.10. The Freeboard form developed by Steve Stell will be added to the reporting forms as Attachment D.10. See B.1.21.f., (formerly), now I.B.20.f. above.</p>					

MEMORANDUM

DEPARTMENT OF ENVIRONMENTAL QUALITY

PIEDMONT REGION-KILMARNOCK OFFICE

429 Church Street P. O. Box 669 Kilmarnock, VA 22482

SUBJECT: Coles Point Site Visit 9/25/02

TO: File

FROM: Denise Mosca

DATE: 9/25/02

COPIES: file

I met Westmoreland County's consultants (Resource International) and Reed Barrows from the VDH at the site for the purpose of verifying application information and observing the groundwater monitoring well placement as they had just been installed. The weather has been dry, but a stream to the north west of the property was flowing. A drainage swale that bisects the property was dry. The site has been timbered and bare. The well locations seem generally well placed, with one upgradient well across the street from the spray site in the woods, and 5 downgradient wells on the 50-acre field. The six wells appear to be well-placed according to the determined direction of flow. However, they are located in the sprayfield and not the buffer area. The engineers have not put the wells where they would be subject to the spray, they gave them a "buffer zone" to themselves. Reed Barrows of the VDH said he thought the locations were adequate.

W. Tayloe Murphy, Jr.
Secretary of Natural
Resources



Joseph H. Maroon
Director

COMMONWEALTH of VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

203 Governor Street, Suite 206

Richmond, Virginia 23219-2094

Phone (804) 786-2064 FAX: (804) 786-1798 TDD (804) 786-2121

May 12, 2003



Department of Environmental Quality
Denise Mosca
P.O. Box 669
Kilmarnock, Virginia 22482

Dear Ms. Mosca,

At your request we have reviewed the document on the Coles Point wastewater treatment facility located in Westmoreland County prepared by Earth Tech, Inc. and Resource International, Ltd. dated May 1, 2003 and have the following comments.

The document implies that the Department of Conservation and Recreation has criteria for developing a water budget and that the nutrient management plan was developed in accordance with this criteria. The Department of Conservation and Recreation does not have criteria for water budget analysis and if we developed one it would not appear as the one developed for Coles Point.

Nutrient Management Standards and Criteria, Revised November 1995 does not contain nutrient recommendations for Reed Canarygrass and we would not support a 360 pounds of nitrogen per acre uptake capacity. When this cool season grass is produced we utilize the nutrient recommendations contained in the Virginia Cooperative Extension Agronomy Handbook, revised 2000. The recommended annual fertilization ranges for nitrogen, phosphorus and potassium of Reed Canarygrass in the Agronomy Handbook are 120-200, 40-90, and 85-185 respectively.

We have the following observations in response to your question concerning whether the site should be classified as a State and Tetotum and would it support using 1" per day permeability. The soil survey for Westmoreland County indicates predominate soils on the site are Lumbee and Tetotum not State and Tetotum. Lumbee is a hydrologic group D soil. Hydrologic group D soils have a very slow infiltration rate and thus a high runoff potential. We question if it would be at all suitable for wastewater irrigation. Additionally, according to Virginia Tech, the Lumbee soil is not suitable for hay production unless it is drained.

The calculation for plant availability nitrogen indicates that only 20% of the nitrate (NO₃) would be available. We would consider that 100% of the nitrate would be plant available, which would significantly change the amount of plant available nitrogen applied by irrigation. Additionally, if the actual effluent analysis is higher than what was used in the NMP, the cropland required to appropriately utilize the effluent may be considerably more than what is currently available.

If you have questions concerning these comments please call.

Sincerely,

A handwritten signature in black ink, appearing to read "Eric R. Capps", with a stylized flourish at the end.

Eric R. Capps
Nutrient Management Coordinator
Division of Soil and Water Conservation

cc: Timothy Sexton, Earth Tech, Inc
Russ Perkinson, DCR
Joe Garner, DCR

United States Department of Agriculture



Natural Resources Conservation Service
Technical and Administrative Support Team
100D Dominion Drive
Farmville, VA 23901



June 13, 2003

Denise M. Mosca, Environmental Engineer Sr.
Department of Environmental Quality
P.O. Box 669
Kilmarnock, Virginia 22482

RE: Coles Point Proposed Municipal Spray Irrigation Wastewater System, Westmoreland County, Virginia VPA01423

Dear Denise:

On June 11, 2003 we made a site visit to the Westmoreland County Sewage Treatment Plant on Coles Point Road (SR 612) to confirm a soil type mapped as part of a site investigation by Resource International, Ltd. of an area proposed for spray irrigation of municipal wastewater (Project 94024.27).

The soil information on Resource International Layout Plan Sheet Figure 3 (site plan) has map unit 100, Bertie loam, 0 to 2% slopes on field 1A and parts of fields 1B and 2A. The *Soil Survey of Westmoreland County, Virginia* (August, 1981) has this area mapped as map unit 10 – Lumbee loam. The Bertie soil was not mapped as part of this published soil survey. The Lumbee soil is a poorly drained, hydric soil and would be within a jurisdictional wetland delineation under normal circumstances. The somewhat poorly drained Bertie soil would be an expected inclusion in Lumbee. In my opinion, the Bertie soil is a good name for the areas indicated as map unit 100 on the site plan. This is based on my on-site investigation and a review of the soil profile descriptions furnished by Resource International.

The Bertie soil (fine-loamy, mixed, semiactive, thermic Aeric Endoaquults) is a very deep, somewhat poorly drained soil with moderate permeability and slow surface runoff. It is not a hydric soil. In *VALUES* the Bertie soil is in soil management group J and in productivity group I for grasses and hay. It is in hydrologic group C and has a leaching index of 6. This would indicate a moderate leaching potential.

If you need any additional information or have any questions, please contact me.

A handwritten signature in black ink, appearing to read "John C. Nicholson".

John C. Nicholson
Soil Resource Specialist

Cc: Debbie A. Bullock, District Conservationist, NRCS, Warsaw, VA
Eric Capps, Nutrient Management, DCR, Richmond, VA
Norm Risavi, Westmoreland County, VA

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JUN 27 1988

EPA-600/2-76-250
November 1976

RESOURCE
INTERNATIONAL, LTD.

USE OF CLIMATIC DATA IN ESTIMATING STORAGE DAYS FOR
SOILS TREATMENT SYSTEMS

By

Dick M. Whiting
National Climatic Center
Environmental Data Service
National Oceanic and Atmospheric Administration
Asheville, North Carolina 28801

Interagency Agreement
EPA-IAG-D5-F694

Project Officer

Richard E. Thomas
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ROBERT S. KERR ENVIRONMENTAL RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U. S. ENVIRONMENTAL PROTECTION AGENCY
ADA, OKLAHOMA 74820

Station	Normal January Temp. (°F)	Normal Annual Precip. (in.)	EPA-1	EPA-2	General Period	Station	Normal January Temp. (°F)	Normal Annual Precip. (in.)	EPA-1	EPA-2	General Period
<u>Alabama</u>						<u>North Carolina</u>					
Mobile	51	67	6	15	1949-73	Charlotte	42	42	14	12	1949-73
Selma	49	52	6	20	1949-73	Raleigh	41	43	21	14	1949-73
Thomasville	45	56	9	25	1953-74	Weldon	41	43	29	11	1926-50
						Wilmington	46	54	7	11	1949-73
<u>Arkansas</u>						<u>Oregon</u>					
Dumas	44	50	21	19	1951-71	Eugene	39	43	32	35	1948-73
Little Rock	40	49	19	12	1949-72	Medford	37	21	22	21	1948-72
<u>California</u>						Roseburg	41	34	15	22	1935-64
Los Angeles	55	12	4	5	1952-69	Salem	39	41	29	36	1948-73
San Francisco	48	20	7	13	1949-72	<u>South Carolina</u>					
<u>Florida</u>						Charleston	49	52	6	24	1948-73
Avon Park	63	55	5	13	1945-72	Columbia	45	46	7	15	1949-73
Daytona Beach	58	50	5	8	1955-73	Conway	47	52	8	9	1945-73
Tampa	60	49	5	16	1953-73	<u>Tennessee</u>					
<u>Georgia</u>						Crossville	35	57	55	24	1953-73
Augusta	46	43	7	10	1949-72	<u>Texas</u>					
Macon	48	44	7	12	1949-72	Amarillo	36	20	27	11	1949-71
<u>Louisiana</u>						Corpus Christi	56	29	5	13	1951-72
Lafayette	52	57	5	12	1948-73	Dallas	45	36	10	15	1948-72
Lake Providence	46	53	16	19	1951-72	El Paso	44	8	6	0	1948-72
Leesville	50	54	6	35	1950-73	Wichita Falls	42	27	17	8	1950-72
Monroe	47	50	10	12	1949-72	<u>Washington</u>					
Shreveport	47	45	9	11	1949-72	Longview	38	46	49	60	1948-73
Winnfield	48	55	8	16	1950-73	Olympia	37	51	45	65*	1949-73
<u>Mississippi</u>						Vancouver	38	40	34	31	1924-50
Aberdeen	45	53	13	24	1951-72	Walla Walla	33	16	51	14	1950-73
Clarksdale	43	49	21	18	1949-72						
Columbia	50	61	9	33	1947-73						
Meridian	47	52	15	14	1948-73						
Pontotoc	43	55	19	20	1949-71						
Stoneville	44	50	17	17	1951-72						

* This station shows 145 storage days when processed under EPA-2 (10%)

Fig. 2 Comparison between maximum annual storage days estimated from EPA-1 and EPA-2 programs

STATION 1 583 BAY MINETTE, AL AMC# 6.0 DEPLETION RATE=0.75				STATION 168295 SCHRIEVER, LA AMC# 6.0 DEPLETION RATE=0.75				STATION 319191 WELDON, NC AMC# 6.0 DEPLETION RATE=0.75				STATION 445120 LYNCHBURG, VA AMC# 9.0 DEPLETION RATE=0.75			
BEG. DATE	END. DATE	#DAYS	PERCENTILES	BEG. DATE	END. DATE	#DAYS	PERCENTILES	BEG. DATE	END. DATE	#DAYS	PERCENTILES	BEG. DATE	END. DATE	#DAYS	PERCENTILES
490322	490329	8	0.05 13.0	480301	480317	16	0.05 15.3	260311	260314	4	0.05 10.7	480124	480202	10	0.05 23.0
500831	500906	7	0.10 13.0	490328	490409	13	0.10 13.3	270110	270116	7	0.10 10.0	490103	490106	4	0.10 16.8
510317	510324	8	0.25 8.5	500402	500407	6	0.25 8.0	280128	280201	5	0.25 7.0	500127	500202	7	0.25 10.0
520215	520224	10	0.50 7.0	510328	510402	6	0.50 7.0	291223	291225	3	0.50 5.0	511214	511221	8	0.50 7.5
531204	531216	13		520331	520406	7		300116	300116	11		520125	520131	7	
541231	550101	2		530716	530720	5		310112	310116	5		530102	530106	5	
550413	550425	13		540729	540803	6		321211	321220	10		540110	540118	9	
560311	560318	8		550206	550209	4		330208	330212	5		550201	550207	7	
570405	570412	8		560930	561008	9		340226	340301	4		560313	560316	4	
581231	590102	3		570604	570610	7		351223	360101	10		570205	570212	8	
590319	590525	7		580911	580917	7		360127	360202	7		580206	580220	15	
600402	600407	6		590530	590612	14		371209	371214	6		591218	591220	3	
611210	611218	9		601224	601226	3		380618	380622	5		600302	600314	13	
620331	620412	13		610907	610914	8		390625	390902	9		611227	620103	8	
630721	630727	7		620109	620112	4		400124	400201	9		621209	621215	7	
640108	640112	5		631109	631116	8		410307	410309	3		630118	630129	11	
650930	651009	10		641003	641009	7		421221	421223	3		640209	640213	5	
661231	670106	7		651218	651223	6		430214	430216	3		650130	650205	7	
671210	671213	4		660210	660217	8		441127	441201	5		661223	670101	10	
681231	690105	6		670205	670212	8		451229	460102	5		671228	680117	21	
690816	690823	8		681230	681231	2		460411	460413	3		680123	680126	4	
700106	700111	6		690409	690419	11		470118	470121	4		690120	690123	4	
710905	710908	4		701027	701030	4		480208	480213	6		700117	700124	7	
721221	721225	5		710907	710911	5		490511	490512	2		710113	710205	24	
730329	730401	4		721220	721224	5		501229	501230	3		720201	720210	10	
740331	740412	13		730416	730423	8		510116	510126	11		730126	730203	9	
				480301	480317	16		300116	300126	11		710113	710205	24	

Fig. 10 Summary tables showing annual estimated storage days for four stations (EPA-2)

STATION	LENGTH OF FREEZE PERIOD (10 %)	ESTIMATED STORAGE DAYS (10 %)	FREEZE INDEX (10 %) (BASE 32 °F)	LENGTH OF MAXIMUM FREEZE PERIOD (DAYS)	ESTIMATED MAXIMUM STORAGE DAYS	NORMAL JANUARY TEMPERATURE	GROWING SEASON (DAYS)	YEARS
BURLINGTON, VT	138	134	1800	143	136	16.8	148	25
BLACKSTONE, VA	016	025	0100	026	031	38.3	181	24
HOT SPRINGS, VA	080	066	0338	101	067	31.6	135	22
NORFOLK, VA	013	015	0059	017	022	40.5	219	25
WASHINGTON, DC/NATIONAL	039	034	0122	062	047	35.6	200	25
LONGVIEW, WA	021	029	0104	028	049	38.2	182	24
OLYMPIA, WA	034	035	0227	034	045	37.2	344	23
SEATTLE, WA	022	033	0081	034	036	38.2	233	25
SPOKANE, WA	105	100	0953	124	106	25.4	169	25
SUNNYSIDE, WA	058	050	0536	102	059	30.5	158	25
VANCOUVER, WA	028	028	0192	033	034	38.4	233	23
WALLA WALLA, WA	036	042	0476	054	051	33.4	202	25
WFNATCHEE, WA	093	087	0849	110	122	26.6	188	22
BLUESTONE DAM, WV	065	052	0322	084	058	31.1	150	25
CHARLESTON, WV	065	044	0272	084	049	34.5	193	25
MORGANTOWN, WV	072	060	0486	085	070	31.5	165	25
ASHLAND, WI	147	148	2353	149	149	12.1	109	22
EAU CLAIRE, WI	144	141	2339	148	147	11.7	151	24
GREEN BAY, WI	140	135	1932	148	139	15.4	161	25
LACROSSE, WI	139	127	1925	146	134	16.1	161	25
MADISON, WI	134	119	1700	146	125	16.8	177	25
RHINFLANDER, WI	146	149	2344	147	156	12.3	085	21
WEYERHAEUSER, WI	145	145	2289	150	148	11.3	125	21
AFTON, WY	149	144	2163	159	156	14.3	018	25
CASPER, WY	136	095	1140	138	101	23.2	130	25
GILLETTE, WY	134	108	1229	125	113	21.7	129	22
ROCK SPRINGS, WY	145	136	1718	151	142	19.2	060	25
WHEATLAND, WY	099	058	0536	127	066	28.9	102	25

Table 3 Selected information for stations, EPA-1 program

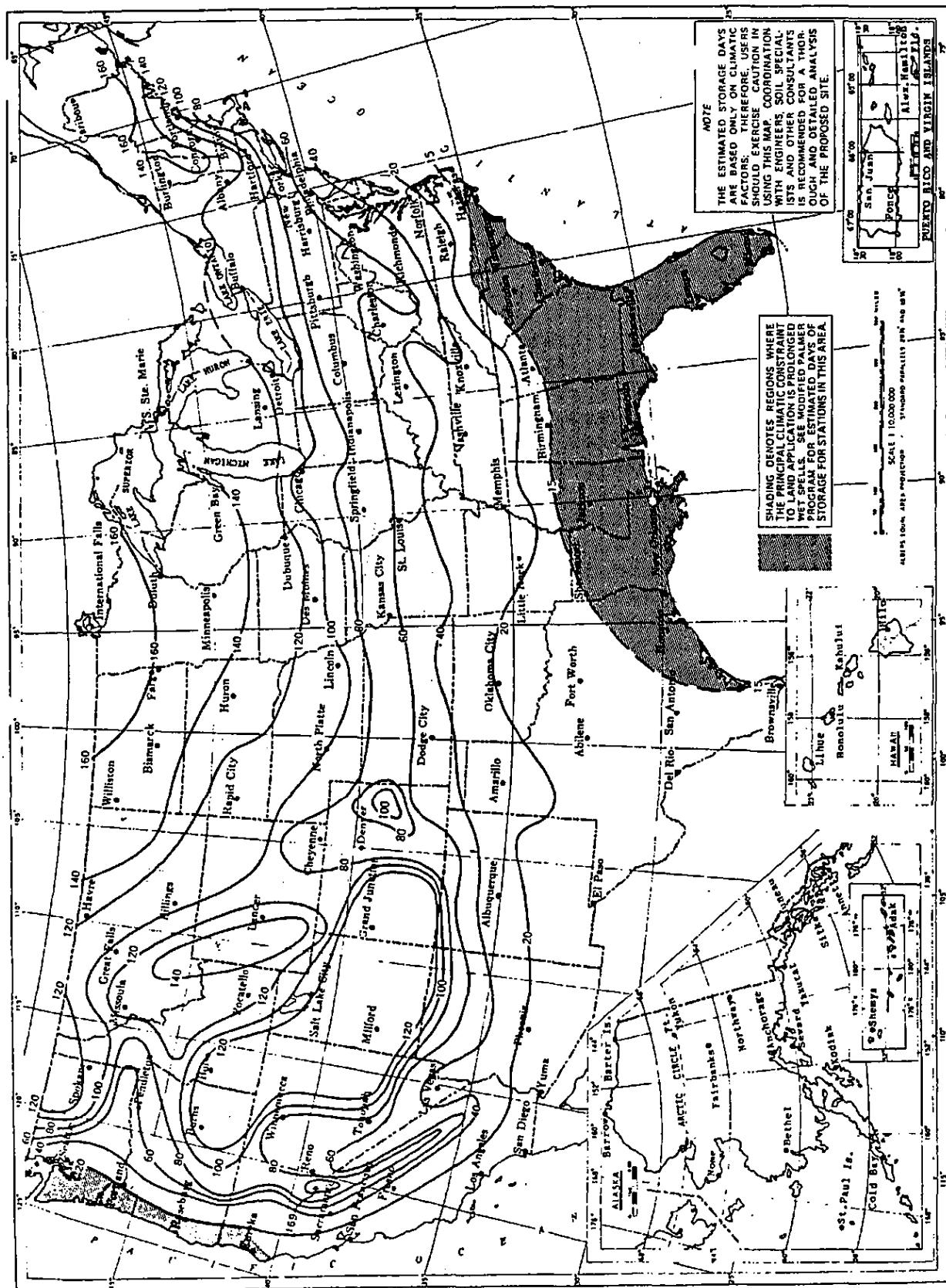
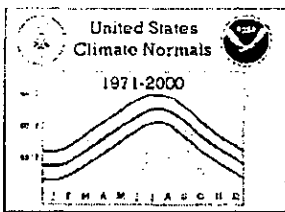


Fig. 1 Estimated maximum annual storage days from EPA-1 program



Monthly Precipitation Probabilities and Quintiles, 1971-2000 CLIMATOGRAPHY OF THE UNITED STATES NO. 81, Supplement No. 1

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Monthly Precipitation (inches)

Station Description	Quin Prob	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ANN
437054 1V4 SAINT JOHNSBURY VT	Q0 MIN	0.41	0.37	1.01	0.59	0.55	1.24	1.19	1.56	0.95	0.84	1.51	1.14	
	0.1	1.13	0.87	1.58	1.31	1.15	1.66	2.11	2.02	1.52	1.46	1.89	1.34	31.71
	Q1 0.2	1.54	1.15	1.85	1.67	1.63	2.20	2.58	2.58	2.00	1.90	2.28	1.75	33.86
	Q2 0.4	2.24	1.62	2.28	2.26	2.49	3.10	3.30	3.48	2.79	2.62	2.88	2.42	36.89
	0.5	2.60	1.86	2.48	2.55	2.95	3.55	3.65	3.92	3.19	2.99	3.17	2.76	38.25
	Q3 0.6	2.99	2.12	2.69	2.87	3.45	4.04	4.03	4.40	3.62	3.38	3.48	3.13	39.64
	Q4 0.8	4.06	2.82	3.22	3.70	4.83	5.37	4.99	5.67	4.78	4.43	4.27	4.12	43.00
	0.9	5.00	3.43	3.67	4.41	6.07	6.52	5.80	6.76	5.78	5.33	4.93	4.97	45.64
	Q5 MAX	6.80	4.93	4.22	6.23	7.88	9.65	7.24	7.73	8.59	6.45	7.04	7.91	
	Q0 MIN	0.49	0.54	0.96	1.21	0.88	0.47	1.15	0.73	0.02	0.01	0.93	0.56	
445120 LYH LYNCHBURG MUNICIPAL AP VA	0.1	1.25	1.26	1.43	1.59	1.59	1.00	1.84	1.20	0.45	0.42	1.22	1.25	33.05
	Q1 0.2	1.76	1.70	1.98	2.06	2.18	1.56	2.45	1.70	0.93	0.85	1.67	1.72	36.20
	Q2 0.4	2.66	2.44	2.93	2.82	3.18	2.60	3.48	2.56	2.05	1.83	2.45	2.50	40.71
	0.5	3.13	2.81	3.42	3.20	3.70	3.18	4.00	3.02	2.75	2.44	2.86	2.91	42.77
	Q3 0.6	3.65	3.23	3.97	3.62	4.26	3.83	4.57	3.52	3.60	3.17	3.30	3.35	44.90
	Q4 0.8	5.08	4.33	5.44	4.72	5.80	5.67	6.10	4.90	6.21	5.42	4.51	4.56	50.10
	0.9	6.36	5.31	6.75	5.67	7.16	7.37	7.43	6.14	8.81	7.63	5.57	5.62	54.24
	Q5 MAX	7.97	6.08	9.24	7.95	9.07	9.97	10.30	7.10	12.57	11.40	8.77	7.15	
	Q0 MIN	1.05	0.84	0.75	0.43	0.64	1.10	0.36	0.74	0.26	0.01	0.97	0.67	
	0.1	1.97	1.52	1.74	1.22	1.78	1.40	1.59	1.31	0.92	0.71	1.18	1.15	35.38
446139 ORF NORFOLK INTL AP VA	Q1 0.2	2.48	1.97	2.30	1.71	2.28	1.95	2.35	2.01	1.51	1.20	1.61	1.59	38.57
	Q2 0.4	3.29	2.72	3.25	2.56	3.08	2.88	3.72	3.32	2.66	2.19	2.33	2.33	43.14
	0.5	3.69	3.09	3.73	3.00	3.48	3.37	4.46	4.04	3.30	2.76	2.69	2.71	45.22
	Q3 0.6	4.12	3.49	4.25	3.50	3.92	3.90	5.29	4.86	4.05	3.42	3.10	3.14	47.36
	Q4 0.8	5.25	4.56	5.65	4.84	5.06	5.36	7.58	7.15	6.19	5.34	4.19	4.29	52.59
	0.9	6.21	5.48	6.88	6.04	6.04	6.65	9.67	9.26	8.19	7.15	5.15	5.31	56.74
	Q5 MAX	9.93	8.21	10.36	7.25	10.12	8.31	14.37	14.32	13.80	10.12	5.71	6.10	
	Q0 MIN	0.64	0.48	1.16	0.65	0.91	0.38	0.51	0.97	0.26	0.01	0.67	0.40	
	0.1	1.46	1.18	1.62	1.29	1.93	1.14	1.74	1.49	0.90	0.59	1.10	0.96	34.81
	Q1 0.2	1.96	1.60	2.20	1.74	2.45	1.66	2.41	2.10	1.48	1.08	1.54	1.42	37.65
447201 RIC RICHMOND BYRD INTL AP VA	Q2 0.4	2.80	2.32	3.19	2.50	3.28	2.59	3.57	3.15	2.61	2.13	2.31	2.25	41.68
	0.5	3.23	2.69	3.70	2.88	3.70	3.09	4.17	3.71	3.24	2.75	2.72	2.69	43.50
	Q3 0.6	3.70	3.10	4.25	3.31	4.14	3.64	4.83	4.32	3.97	3.48	3.16	3.19	45.38
	Q4 0.8	4.96	4.20	5.75	4.45	5.31	5.16	6.64	5.99	6.07	5.65	4.39	4.57	49.94
	0.9	6.06	5.17	7.07	5.45	6.31	6.54	8.23	7.48	8.04	7.75	5.48	5.83	53.54
	Q5 MAX	7.97	5.97	8.65	7.31	8.87	8.82	12.29	10.58	16.60	9.39	6.99	7.07	
	Q0 MIN	0.29	0.65	0.88	0.48	1.04	0.62	0.45	0.74	0.15	0.02	0.68	0.60	
	0.1	1.01	1.07	1.53	1.14	1.93	0.99	1.35	1.30	0.76	0.39	1.02	1.15	32.84
	Q1 0.2	1.48	1.52	2.08	1.67	2.51	1.53	1.93	1.84	1.30	0.78	1.49	1.55	35.81
	Q2 0.4	2.34	2.31	3.00	2.63	3.45	2.54	2.97	2.80	2.41	1.69	2.33	2.24	40.07
447285 ROA ROANOKE WOODRUM AP VA	0.5	2.79	2.72	3.48	3.14	3.92	3.09	3.51	3.30	3.04	2.26	2.78	2.59	42.00
	Q3 0.6	3.31	3.18	4.00	3.70	4.44	3.72	4.12	3.85	3.78	2.94	3.29	2.97	44.00
	Q4 0.8	4.73	4.44	5.40	5.28	5.80	5.49	5.78	5.38	5.94	5.02	4.69	4.01	48.87
	0.9	6.02	5.58	6.63	6.71	6.98	7.12	7.28	6.75	7.99	7.08	5.96	4.92	52.74
	Q5 MAX	7.97	8.00	7.91	11.35	7.50	10.32	10.09	9.54	11.09	9.89	12.36	5.61	
	Q0 MIN	0.88	0.81	0.30	0.40	0.43	0.90	0.29	0.67	0.68	0.01	0.67	0.52	
	0.1	1.76	1.38	1.55	1.28	1.14	1.11	1.18	1.12	1.14	0.67	0.97	1.25	31.37
	Q1 0.2	2.22	1.80	2.11	1.67	1.63	1.54	1.71	1.70	1.66	1.11	1.37	1.70	34.06
	Q2 0.4	2.97	2.50	3.07	2.30	2.51	2.29	2.68	2.77	2.60	1.97	2.08	2.47	37.89
	0.5	3.33	2.85	3.57	2.62	2.98	2.68	3.19	3.36	3.10	2.46	2.45	2.86	39.63
893739 WAL WALLOPS ISLAND FLIGHT FA VA	Q3 0.6	3.73	3.24	4.11	2.97	3.50	3.11	3.77	4.02	3.66	3.02	2.86	3.29	41.42
	Q4 0.8	4.77	4.26	5.57	3.90	4.93	4.27	5.35	5.87	5.21	4.65	3.99	4.46	45.78
	0.9	5.65	5.14	6.87	4.70	6.21	5.31	6.79	7.57	6.60	6.18	4.99	5.50	49.22
	Q5 MAX	6.86	5.83	9.47	4.98	8.06	7.60	8.25	13.07	8.15	6.86	5.94	8.76	
	Q0 MIN	0.40	0.25	0.99	0.33	1.19	0.52	0.94	0.44	0.78	0.06	0.24	0.68	
	0.1	1.21	0.89	1.59	1.29	1.97	1.22	1.44	1.15	1.17	0.71	1.03	1.01	32.61
	Q1 0.2	1.65	1.30	2.07	1.74	2.54	1.82	1.94	1.70	1.73	1.18	1.52	1.46	35.45
	Q2 0.4	2.38	2.02	2.87	2.52	3.46	2.91	2.80	2.71	2.74	2.15	2.40	2.26	39.51
	0.5	2.76	2.41	3.27	2.91	3.92	3.50	3.23	3.25	3.29	2.70	2.86	2.68	41.35
	Q3 0.6	3.17	2.84	3.70	3.35	4.41	4.16	3.71	3.86	3.90	3.33	3.39	3.16	43.25
448903 IAD WASHINGTON DULLES INTL VA	Q4 0.8	4.29	4.03	4.86	4.52	5.72	6.00	5.00	5.56	5.61	5.17	4.85	4.46	47.87
	0.9	5.27	5.11	5.86	5.56	6.85	7.67	6.13	7.10	7.16	6.91	6.18	5.64	51.54
	Q5 MAX	6.61	5.83	7.65	7.35	10.26	18.19	7.23	10.71	11.26	9.19	7.09	6.06	
	Q0 MIN	0.38	0.42	0.74	0.03	0.75	0.95	1.01	0.59	0.32	0.02	0.29	0.65	
	0.1	1.37	0.94	1.55	0.87	1.75	1.11	1.64	1.31	0.81	0.69	0.95	1.06	30.91
	Q1 0.2	1.82	1.32	2.05	1.27	2.27	1.57	2.14	1.80	1.35	1.15	1.39	1.50	33.53
	Q2 0.4	2.56	1.98	2.88	2.01	3.11	2.36	2.96	2.65	2.43	2.07	2.19	2.28	37.26
	0.5	2.93	2.33	3.30	2.40	3.54	2.77	3.37	3.09	3.05	2.59	2.62	2.69	38.95
	Q3 0.6	3.34	2.71	3.76	2.84	4.00	3.24	3.82	3.57	3.76	3.20	3.10	3.14	40.69
	Q4 0.8	4.44	3.76	4.98	4.06	5.22	4.49	5.01	4.88	5.81	4.94	4.43	4.39	44.93
448906 DCA WASHINGTON REAGAN NTL A VA	0.9	5.39	4.69	6.05	5.16	6.27	5.62	6.04	6.03	7.74	6.59	5.64	5.50	48.28
	Q5 MAX	7.11	5.62	8.45	6.88	7.77	11.53	7.16	7.18	12.36	8.65	6.05	6.03	

APPENDIX E

NUTRIENT MANAGEMENT PLAN

Nutrient Management Plan

Site:

Coles Point
Westmoreland County, Virginia 22520

Prepared for:

Resource International, Ltd.
9560 Kings Charter Drive
Ashland, Virginia 23005

Prepared by:

Earth Tech, Inc.
7870 Villa Park Drive, Suite 400
Richmond, Virginia 23228

August 9, 2002

Earth Tech Project No. 57461

Nutrient Management Plan

Site:
Coles Point
Westmoreland County, Virginia 22520

Prepared for:
Resource International, Ltd.
9560 Kings Charter Drive
Ashland, Virginia 23005

Prepared by:
Earth Tech, Inc.
7870 Villa Park Drive, Suite 400
Richmond, Virginia 23228

August 9, 2002

Earth Tech Project No. 57461

Author: Eric Smither

Title: Environmental Scientist

Date: August 9, 2002

Reviewer: Tim P. Lester C.N.M.P.

Title: Senior Natural Resource Scientist

Date: August 9, 2002

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EXECUTIVE SUMMARY

Earth Tech, Inc., has prepared this Nutrient Management Plan (NMP) on behalf of Resource International, Ltd., to determine the suitability of irrigating agricultural crops by spraying them with treated effluent from the Westmoreland County wastewater treatment plant (WWTP). The spray area, consisting of two fields including the treatment units, will be located on the eastern side of U.S. Route 612, approximately 1.5 miles south of U.S. Route 724 in Westmoreland County, Virginia. The estimated flow for the Coles Point Community WWTP is 23,855,500 gallons per year. According to the application schedule, the agricultural area will receive 24,906,372 gallons per year, including rainfall accumulated in the holding ponds located on site. Total acreage possible for irrigation is 50.4 acres. Acreage receiving irrigation will total 38.4 acres in fields A and B, leaving approximately 25% for reserve area.

The effluent that is discharged from the WWTP will have a concentration of plant-available nitrogen that will require minor amounts of nitrogen to be applied at planting and again after the corn is approximately 14-18 inches tall (layby). The crops will be cultivated using no-till or minimum-till techniques to limit soil erosion within the application area. The spray schedule must be followed in order to achieve the necessary acre-inch requirements and to prevent excess run-off from the site.

The agricultural crops for this site will be corn and wheat. The application schedule indicates the dates for planting, fertilizing, liming, and harvesting, along with the amount to be sprayed on each field. The NMP implementation should start in the fall of 2002 with the following crops to be planted for the first four years:

First year: Corn followed by no-till winter wheat
Second year: No-till corn followed by wheat
Third year: Corn followed by barley or wheat
Fourth year: No-till corn followed by wheat

Soil samples will need to be submitted to a qualified agricultural laboratory for analysis of the presence and concentration of potassium and magnesium. The laboratory will provide recommendations for additional application, if warranted.

1.0 INTRODUCTION

Earth Tech, Inc., has prepared this Nutrient Management Plan (NMP) to address the nutrient supply needs of agricultural production activities while minimizing potential adverse environmental impacts. The County of Westmoreland proposes to spray-irrigate approximately 50 acres of corn, wheat, and/or barley crops with treated domestic effluent from the community's wastewater treatment plant (WWTP). A Site Location Map and a Site Detail Map are included as Figures 1 and 2, respectively. This NMP has been completed in general accordance with the guidelines set forth in the *Nutrient Management Handbook*, Second Edition, Department of Conservation and Recreation, 1993.

1.1 Objectives

The principal objective of this NMP is to spray treated wastewater effluent over cropland to dispose of and reuse the community's wastewater, reduce the cost of using commercial fertilizers applied to crops due to the nutrient availability in the effluent, and raise corn and small-grain crops to feed local livestock.

1.2 Scope of Work

The following general work tasks were performed to meet the project objectives:

- Water Budget Analysis
- Nutrient Balance Analysis
- Site Life Analysis
- Crop Recommendations

2.0 NARRATIVE

The effluent that is discharged from the WWTP will have a concentration of plant-available nitrogen that will require minor amounts of nitrogen to be applied at planting and again after the crop is approximately 14-18 inches tall (layby). The crops will be cultivated using no-till or minimum-till techniques to limit soil erosion within the application area. Plant tissue analysis should be conducted during the growing season to determine the amount of supplemental nitrogen, phosphorus, and potassium needed. Soil fertility samples should be taken every fall to determine liming requirements. The spray schedule must be followed in order to achieve the necessary acre-inch requirements and to prevent excess run-off from the site.

2.1 Soil Evaluations

Detailed soil descriptions were performed by Hatcher-Sayre, Inc., of Richmond Virginia, in December 2000 (provided in Appendix A). Soil samples were also collected for laboratory analysis for macro- and micro-nutrients. The laboratory analytical results are presented in Appendix B.

Earth Tech obtained hydraulic conductivity (Ksat) measurements in September 2001 and July 2002. (Refer to Table 1 for detailed Ksat data sheets.) A compact constant head permeameter (CCHP) was used for *in situ* measurement of the saturated hydraulic conductivity of the unsaturated (vadose) zone. The CCHP allows convenient and easy collection of field data for determination of *in situ* Ksat of many porous media. The procedure for measuring Ksat using the CCHP is referred to as the constant-head well permeameter technique, which is also known as the shallow well pump-in technique.

The predominant soil of the application area is Tetotum. These soils are generally very deep and moderately well drained with the seasonal water table between 18 and 22 inches below ground surface (bgs). The surface soil textures consist of fine-sandy loams and subsoil textures of clay loam. The remainder of the soils in the application area is Lumbee and State. State soils are very deep and well drained with a seasonal high water table greater than 36 inches bgs. Lumbee soils are poorly drained, with a seasonal water table between 14 and 30 inches bgs. A Soils Map is included as Figure 3.

2.2 Water Budget Analysis

The water budget for the site was performed using Virginia Department of Conservation and Recreation (DCR) Nutrient Management Standards and Criteria (1995). According to the water budget analysis (included as Appendix C), the application rate of 24 acre-inches per year will meet the specified spray irrigation design criteria with an average daily flow of approximately 90,017 gallons of treated effluent per day.

2.3 Nutrient Balance Analysis

Earth Tech performed the nutrient balance calculations for corn and wheat using Virginia DCR Nutrient Management Standards and Criteria. According to the nutrient balance analysis included as Appendix D, the site will require the application of supplemental nutrients on a yearly basis. Application of gypsum may be required for the first three years of crop cultivation because of the potential for sodium to tie up cation exchange sites in the soil. Earth Tech also recommends that sodium levels in site soils be monitored on a yearly basis in order to determine the potential effect of sodium levels on plant growth.

2.4 Site Life

The site life analysis was performed in accordance with the Virginia Department of Environmental Quality guidelines. The site life analysis, included as Appendix E, indicates that cadmium is the limiting nutrient at the site. At the recommended application rate of 24 acre-inches per year, site soils will reach their capacity to adsorb cadmium in 214 years.

2.5 Land Use

This site was previously a mixed stand of pines and hardwoods bordered by several active small grain farms. The site was clear-cut in July/August of 2001 to allow for agricultural production.

2.6 Wastewater Treatment

The WWTP will produce approximately 24,032,285 gallons of treated effluent per year for use as irrigation. This effluent will be delivered to the application area by a solid set spray irrigation system.

2.7 Method of Application

The method of effluent application, designed by Resource International, will be a solid set irrigation system with impact nozzles, divided into zones to allow for spray field management should local wet spots occur during the growing season. Based on *in situ* hydraulic conductivity tests, the recommended application rate should be ¼-inch per hour, 1 inch per day, and 2 inches per week ("Methods of Soil Analysis Part I Physical and Mineralogical Methods," Klute, A., American Society of Agronomy and the Soil Science Society of America, 1986).

3.0 NUTRIENT MANAGEMENT PLAN IMPLEMENTATION

3.1 Crop Recommendations

The NMP implementation should start in the fall of 2002 with the spreading and turning under of 2 tons per acre of dolomitic limestone in the application area. The following presents the selected crops to be planted for the first four years:

First year: Corn followed by no-till winter wheat
Second year: No-till corn followed by wheat
Third year: Corn followed by barley or wheat
Fourth year: No-till corn followed by wheat

The target planting date for corn should be March 15, 2003, with approximately 24,000 seeds per acre, planted 11 inches apart in rows that are 24 inches on center. While planting, a starter fertilizer should be applied at a rate of 30 pounds per acre (lbs/acre) of nitrogen, 30 lbs/acre of phosphorus, and 85 lbs/acre of potassium. After planting, and if the soil conditions are favorable, the application area should be sprayed with 2 acre-inches of effluent (refer to Appendix F for the application schedule). A pre-emergence herbicide should be used to prevent weeds from competing with the crop for available nutrients. If additional weed control is necessary, use Bicep and Lariat for the corn crop and Heonon for the wheat crop.

During the growing season, tensionmeters must be installed to determine the soil moisture to ensure that the soil is not too saturated to prevent effluent spraying. When tensionmeter readings are less than 10 centibars, do not irrigate. When the tensionmeter readings are greater than 20 centibars, irrigate until the tensionmeter reads approximately 10 centibars; however, do not apply more than 1 inch per day. Refer to the Application Schedule in Appendix C for spray and harvest schedules.

Apply 30 lbs/acre of nitrogen starter fertilizer on corn at planting for the first year. For the first year apply an additional 47 lbs/acre of phosphorus to the no-till corn at layby. Add 9 lbs/acre of potassium with no supplemental nitrogen recommended for wheat unless soil tests indicate otherwise. Perform a nitrate soil test on the top 6 inches of the wheat crops; if the results are above 30 milligrams per liter (mg/L), no nitrogen is recommended at planting.

If significant rain has occurred during the period from October to December (e.g., two or more rainfall events of 2.0 or more inches), there has been little tiller development (less than 3 tillers per plant), the crop is pale green color, and there is an expectation of several days during January and February when temperatures will exceed 50 degrees Fahrenheit, apply 20-25 lbs/acre of nitrogen as top dressing. Irrigate any days when soil moisture is less than 10.0 centibars and temperatures are above 45 Fahrenheit.

Sulfur Loading: 25 mg/L SO_4

The secondary drinking water standard for sulfur is 250 mg/L. The sulfur concentration of the WWTP effluent is below 250 mg/L. Filtrating water reaching the groundwater system is expected to comply with secondary drinking water standards for sulfur.

Sodium Loading: 70 mg/L

$$\text{Sodium Adsorption Ratio (SAR)} = \frac{\text{NA}^7}{\sqrt{\frac{\text{ca} + \text{mg}}{2}}} = \frac{70}{\sqrt{\frac{5.75 + 2.56}{2}}} = \frac{70}{2.04} = 34.3$$

Application of Gypsum is indicated.

Rates of applications will be determined by soil tests following the first year of application.

Total Oxygen Demand (TOD): 70 mg/L COD + 30 mg/L BOD = 100 TOD
100 (5.18) = 518 lbs/acre/year of TOD

Soil is similar to State and Tetotum and would have a weekly loading potential that is greater than the annual loading rate.

3.2 Future Nutrient Testing

A soil sample will need to be submitted to a qualified agricultural laboratory for analysis of the presence and concentration of potassium and magnesium. The laboratory will provide recommendations for additional application, if warranted. The soil sample taken in the fall will determine the number of tons per acre of dolomitic limestone to be applied and incorporated.

4.0 SUMMARY

Earth Tech has prepared this NMP on behalf of Resource International to determine the suitability of irrigating agricultural crops by spraying them with treated effluent from the Westmoreland County WWTP. The spray area, consisting of two fields including the treatment units, will be located on the eastern side of U.S. Route 612, approximately 1.5 miles south of U.S. Route 724 in Westmoreland County, Virginia. The estimated flow for the Coles Point Community WWTP is 23,855,500 gallons per year. According to the application schedule, the agricultural area will receive 24,906,372 gallons per year, including rainfall accumulated in the holding ponds located on site. Total acreage of irrigation is 50.4 acres. Acreage receiving irrigation will total 38.4 acres in fields A and B.

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Soil samples will need to be submitted to a qualified agricultural laboratory for analysis of the presence and concentration of potassium and magnesium. The laboratory will provide recommendations for additional application, if warranted.

5.0 LIMITATIONS

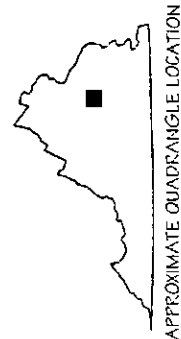
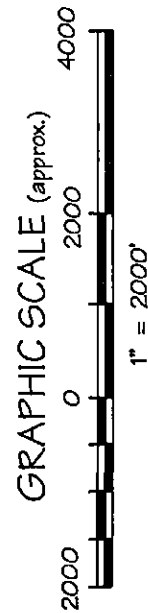
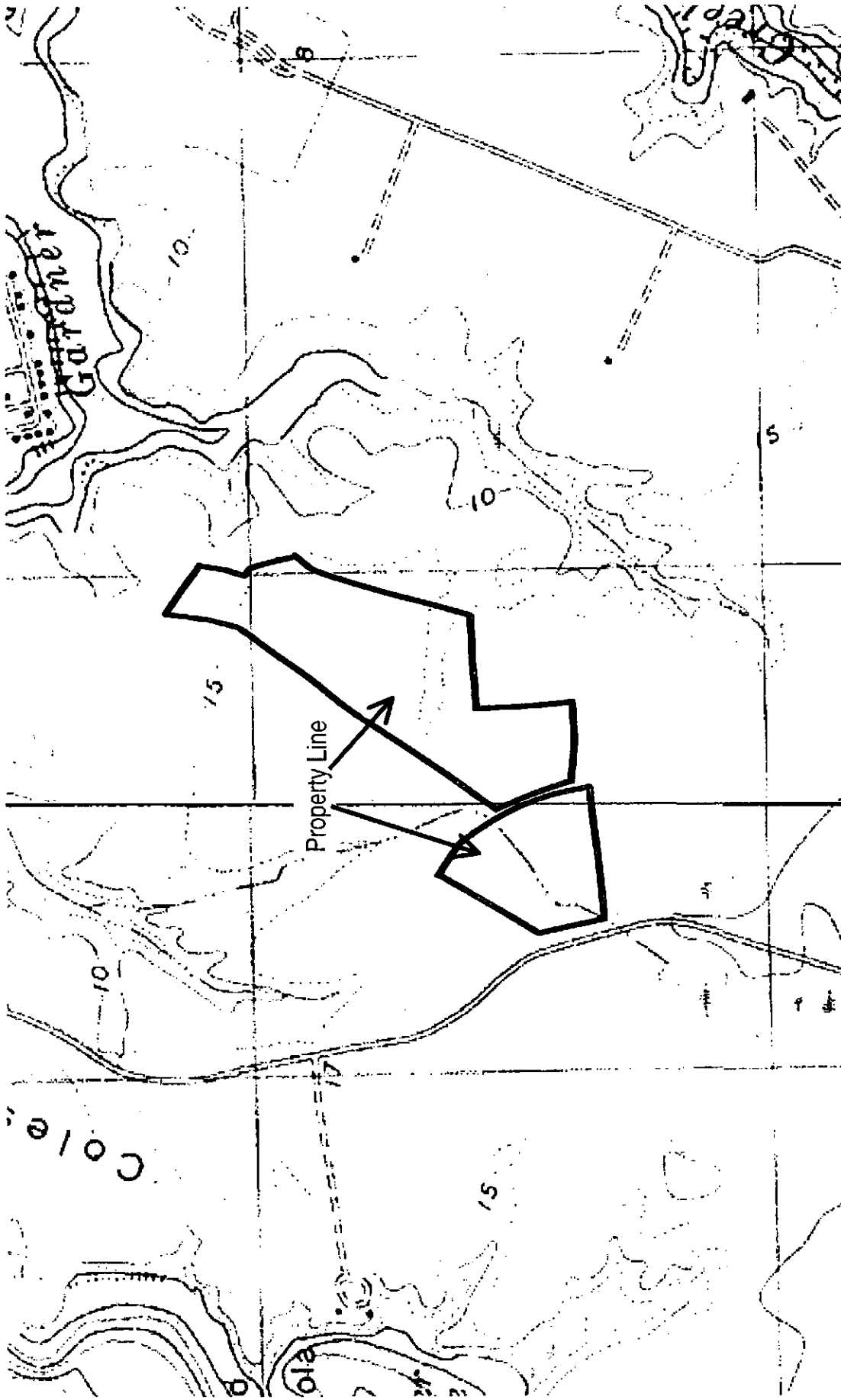
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This report does not constitute legal advice. In addition, Earth Tech makes no determination or recommendations regarding the decision to purchase, sell, or provide financing for this Property.

Figures



SOURCE:
Maptech, Inc. (2001)

PROJECT:		Nutrient Management Plan		EARTHTECH	
PROJECT MANAGER:		Coles Point		FIGURE TITLE:	
Tim Sexton		Westmoreland County, Virginia		Site Location Map	
PROJECT NO:		57461		Westmoreland County, Virginia	
DATE:		08/05/02		SCALE:	
				AS SHOWN	
				FIGURE NO.	
				1	

Ksat Data Sheet

Hole No. K1

Location: Coles Point

Date: 09/19/2001

Temp: 75

Measured (Actual) Water Level in hole:

Initial 20 cm

Final 20 cm

Conversion Factor (CF) 105 cm²

Hole Depth 66 cm

Distance between reference level and soil surface 11 cm

Distance from the hole bottom to the reference level (D) 77 cm

Desired water depth in hole (H) 17.0 cm

Constant-head tube setting (d) 60 cm

Clock Time (h:min)	Reservoir Reading (cm)	Change in Water Level (cm)	Flow Volume (cm ³)	Q (cm ³ /min)	Q (cm ³ /h)	A (Head)	K _{sat} (cm ³ /day)
13:10	47.4	0	105				
13:30	47.2	20	105	0.0009	0.0554	0.000879	1.33
13:50	47.1	40	105	0.0005	0.0277	0.000879	0.67
14:10	47.0	60	105	0.0005	0.0277	0.000879	0.67
14:30	46.8	80	105	0.0009	0.0554	0.000879	1.33
14:50	46.7	100	105	0.0005	0.0277	0.000879	0.67
15:10	46.6	120	105	0.0005	0.0277	0.000879	0.67

Average of last three measurements:

K_{sat} = 0.0370 cm/hour

K_{sat} = 0.89 cm/day

Comments:

Ksat Data Sheet

Hole No. K2

Location: Coles Point

Date: 09/20/2001

Temp: 75

Measured (Actual) Water Level in hole:

Initial 15 cm

Final 15 cm

Conversion Factor (CF) 105 cm²

Hole Depth 66 cm

Distance between reference level and soil surface 11 cm

Distance from the hole bottom to the reference level (D) 77 cm

Desired water depth in hole (H) 16.0 cm

Constant-head tube setting (d) 62 cm

Clock Time (h:min)	Reservoir Reading (cm)	Change in Water Level (cm)	Flow Volume (cm ³)	Q (cm ³ /min)	Q (cm ³ /h)	A (Head)	K _{sat} (cm ³ /day)
15:26	42.2	0	0.0				
15:46	42.0	20	105	0.0010	0.0606	0.000961	1.45
16:06	42.0	40	105	0.0000	0.0000	0.000961	0.00
16:26	42.0	60	105	0.0000	0.0000	0.000961	0.00
16:46	42.0	80	105	0.0000	0.0000	0.000961	0.00
17:07	42.0	100	105	0.0000	0.0000	0.000961	0.00

Average of last three measurements:

K_{sat} = 0.0000 cm/hour

K_{sat} = 0.00 cm/day

Comments:

Hole did not take water.

Ksat Data Sheet

Hole No. K4

Location: Coles Point

Date: 09/20/2001

Temp: 80

Measured (Actual) Water Level in hole:

Initial 16 cm

Final 16 cm

Conversion Factor (CF) 105 cm²

Hole Depth 66 cm

Distance between reference level and soil surface 11 cm

Distance from the hole bottom to the reference level (D) 77 cm

Desired water depth in hole (H) 16.0 cm

Constant-head tube setting (d) 61 cm

Clock Time (h:min)	Reservoir Reading (cm)	Change in Water Level (cm)	Flow Volume (cm ³)	Q (cm ³ /min)	Q (cm ³ /h)	A (Head)	K _{sat} (cm ³ /day)
9:50	47.0	0	0.0				
10:10	46.5	20	0.5	105	0.0025	0.1515	0.000961
10:30	45.3	40	1.2	105	0.0061	0.3636	0.000961
10:50	44.4	60	0.9	105	0.0045	0.2727	0.000961
11:10	43.6	80	0.8	105	0.0040	0.2424	0.000961
11:30	42.8	100	0.8	105	0.0040	0.2424	0.000961

Average of last three measurements:

K_{sat} = 0.2525 cm/hour

K_{sat} = 6.06 cm/day

Comments:

Ksat Data Sheet

Hole No. K100

Location: Coles Point

Date: 07/22/2002

Temp: 95

Measured (Actual) Water Level in hole:

Initial 18 cm

Final 18 cm

Conversion Factor (CF) 105 cm²

Hole Depth 46 cm

Distance between reference level and soil surface 11 cm

Distance from the hole bottom to the reference level (D) 57 cm

Desired water depth in hole (H) 18.0 cm

Constant-head tube setting (d) 39 cm

Clock Time (h:min)	Reservoir Reading (cm)	Δ t (min)	Change in Water Level (cm)	Flow Volume (cm ³)	Q (cm ³ /min)	Q (cm ³ /h)	A (Head)	K _{sat} (cm ³ /day)
10:29	44.5	0	0.0	105				
10:59	43.8	30	0.7	105	0.0020	0.1188	0.000808	2.85
11:29	43.6	60	0.2	105	0.0006	0.0339	0.000808	0.81
11:59	43.5	90	0.1	105	0.0003	0.0170	0.000808	0.41
12:29	43.4	120	0.1	105	0.0003	0.0170	0.000808	0.41
12:59	43.3	150	0.1	105	0.0003	0.0170	0.000808	0.41

Average of last three measurements:

K_{sat} = 0.0170 cm/hour

K_{sat} = 0.41 cm/day

Comments:

Ksat Data Sheet

Hole No. K101

Location: Coles Point

Date: 07/22/2002

Temp: 95

Measured (Actual) Water Level in hole:

Initial 15 cm

Final 15 cm

Conversion Factor (CF) 105 cm²

Hole Depth 66 cm

Distance between reference level and soil surface 11 cm

Distance from the hole bottom to the reference level (D) 77 cm

Desired water depth in hole (H) 15.0 cm

Constant-head tube setting (d) 62 cm

Clock Time (h:min)	Reservoir Reading (cm)	Change in Water Level (cm)	Flow Volume (cm ³)	Q (cm ³ /min)	Q (cm ³ /h)	A (Head)	K _{sat} (cm ³ /day)
10:39	43.6	0	0.0				
11:09	38.1	30	5.5	105	0.0305	1.8314	0.001056
11:39	32.5	60	5.6	105	0.0311	1.8646	0.001056
12:09	25.8	90	6.7	105	0.0372	2.2309	0.001056
12:39	18.0	120	7.8	105	0.0433	2.5972	0.001056
13:09	10.5	150	7.5	105	0.0416	2.4973	0.001056
13:39	7.3	180	3.2	105	0.0118	0.7096	0.001056

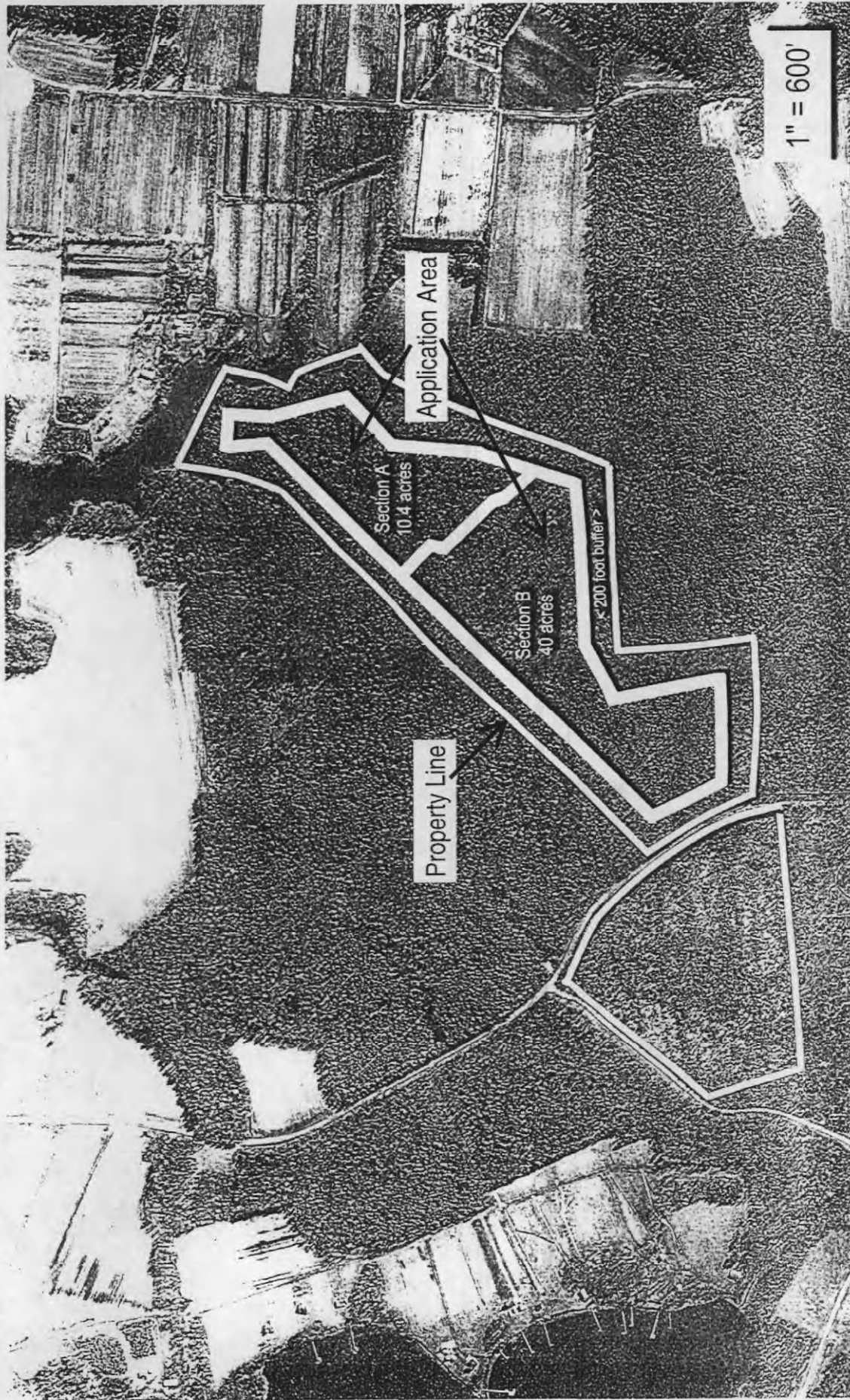
Average of last three measurements:

K_{sat} = 1.9347 cm/hour

K_{sat} = 46.43 cm/day

Comments:

This test will not be used due to variability in water level change.



EARTHTECH



FIGURE TITLE:

Property Layout Map
Westmoreland County, Virginia

DATE: 08/05/02

SCALE: AS SHOWN

FIGURE NO.: 2

PROJECT:

Nutrient
Management Plan
Coles Point
Westmoreland County, Virginia

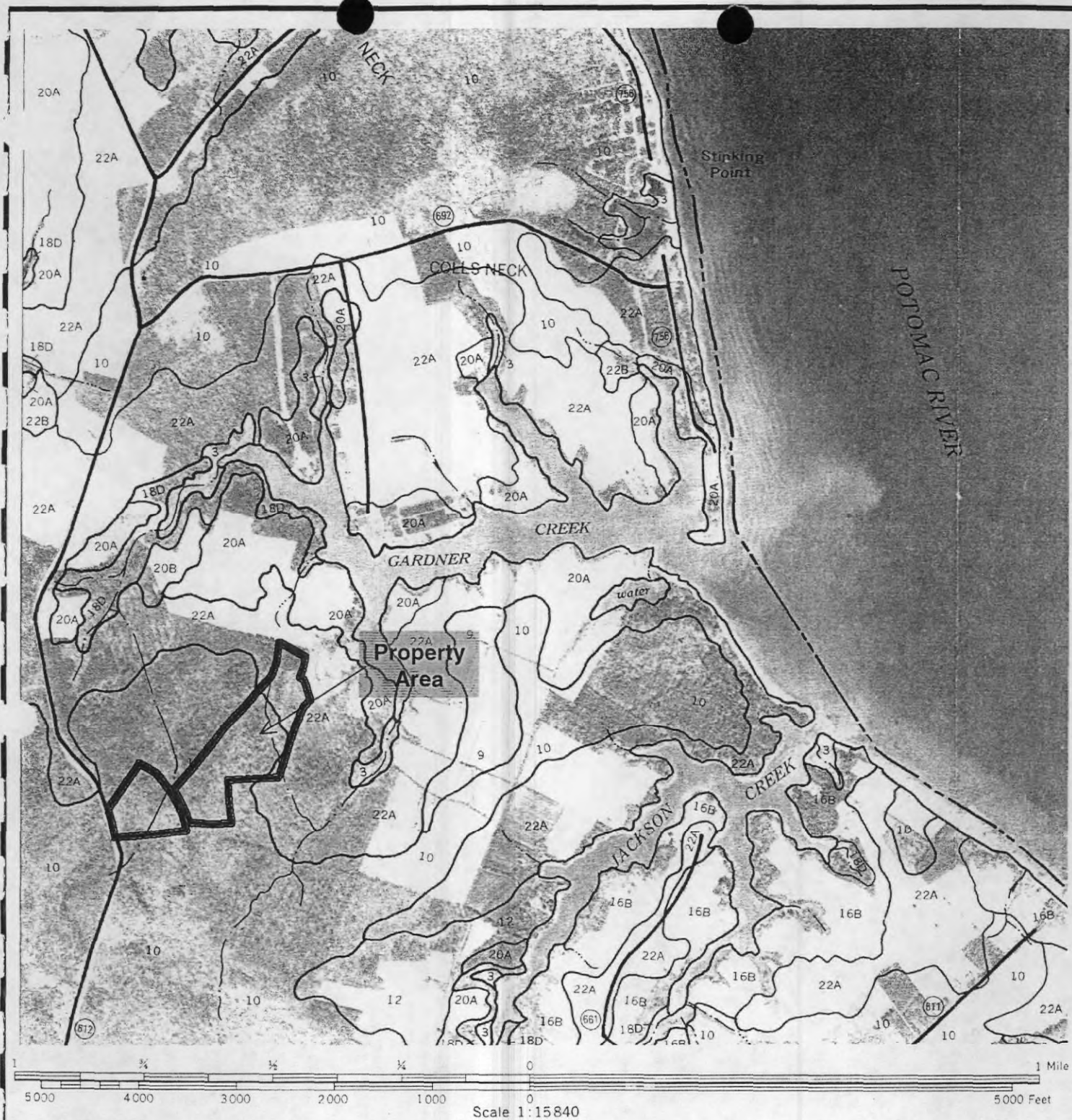
PROJECT MANAGER:
Tim Sexton

PROJECT NO.: 57461



APPROXIMATE QUADRANGLE LOCATION

SOURCE:
RESOURCE INTERNATIONAL, LTD.




SOURCE:
1981 Soil Survey of Westmoreland County, Virginia

LEGEND:
10 = Lumbee
22 = Tetotum



APPROXIMATE QUADRANGLE LOCATION



PROJECT: Nutrient Management Plan Coles Point Westmoreland County, Virginia		EARTH  TECH	
PROJECT MANAGER: Tim Sexton		PROJECT NO.: 57461	
DATE: 08/0502		SCALE: AS SHOWN	
FIGURE TITLE: Soils Map Westmoreland County, Virginia		FIGURE NO.: 3	

Attachment 1
Water Budget Analysis

Water Budget Analysis

Area available for irrigation: 55.7 acres

Amount of irrigation applied per year: 40 ac inches

Acres x inches applied = total inches applied/year = 2228 acre inches per year x 27,154 gallons per acre inch = 60,499,112 gallons per year ÷ 365 days per year equals 165,750 gallons per day.

Nutrient Balance Analysis

Loading calculations: $(\text{conc mg/L}) (\text{flow in m.g.d. } 0.1675) \times 8.34 \text{ lb/yr} \times 365$
55.7 acres

Loading calculations simplified: $(\text{conc/mg/L}) \times 9.0585$

Effluent strengths:

Total N (assumed)	24.26 mg/L
Organic N	5.0 mg/L
NH ₃	1.0 mg/L
NO ₃	18.20 mg/L
P	4.0 mg/L
K	1.5 mg/L

Plant available nitrogen (PAN):

$\text{NO}_3 + 0.2 \times 1.0 \text{ ppm (NH}_3\text{)} + 0.5 \times 5.0 \text{ ppm (Organic N)} = 22.5 \text{ ppm}$

PAN: $22.5 \text{ ppm} \times 9.0585 = 203.8 \text{ lb/ac/year}$

Phosphorous: $4.0 \text{ ppm} \times 9.0585 = 36.24 \text{ lb/ac/yr as P}$
 $36.24 \times 2.29 (\text{conv}) = 82.97 \text{ lb/ac/yr P}_2\text{O}_5$

Potassium: $1.5 \text{ ppm} \times 9.0585 = 13.587 \text{ lb/ac/yr as K}$
 $13.57 \times 1.2 (\text{conv}) = 16.30 \text{ lb/ac/yr as K}_2\text{O}$

Soils found on site:

Soil Series	Soil Mgt Group	Productivity Group		
		Corn	Small Grain	Hay
State	B	Ia	I	I
Tetotum	K	Ib	I	I
Lumbee	OO	V	V	N/S

Soil Series	Productivity Group		
	Yield		
	Corn	Barley	Fescue
State	160 bu/ac	100 bu/ac	4.0 bu/ac
Tetotum	130 sq/ac	100 sq/ac	4.0 tons/ac
Lumbee	650 sq/ac	30 sq/ac	N/S

Nitrogen Recommendations

	Corn	Grain	Hay
State	180 lb/ac/yr	60 lb/ac/yr	40 lb/ac/yr
Tetotum	160-180 lb/ac/yr	60 lb/ac/yr	40 lb/ac/yr
Lumbee	85 lb/ac/yr	40 lb/ac/yr	N/S

County Code 193	Leaching Indexes	Hydrologic Group
State	13	B
Tetotum	6	C
Lumbee	6	D
A = 17	B = 17	C = 6
		D = 6

Crop Recommendations

First 2 years No till corn followed by winter wheat
Third year Barley or no till
Fourth Year Plant to fescue or a land grass hay

First year No till corn additional 30 lb/ac P_2O_5
Starter fertilizer on corn at 30 lb/ac N at planting first year.
Add 85 lb K_2O per acre recommended No supplemental N recommended past started unless soil test prove otherwise.
Barley NO_3 soil test from top 6 inches, if results are above 30 ppm, no nitrogen recommended at planting.

Split applications of Nitrogen recommended on corn 30 lb/ac at planting
Split applications of Nitrogen recommended on small grain 30 lb/ac in the spring
Fall planted small grain recommended

Midwinter (December – January)

If significant rains have occurred during the October to December period (e.g., 2 or more rainfall events of 2.0 or more inches) and there has been little tiller development (less than 3 tillers per plant) and the crop is pale green color, and there is an expectation of several days during January to February when temperatures will exceed 50° F; then apply 20 – 25 lb/N/ac as top dressing. Irrigate any days when soil moisture is <10.0 centibars and temperature is above 45°F.

Use the Nitrate Soil test for wheat and barley to determine Nitrogen application at planting.

Residual Plant Available Nitrogen Years 2-5

ON + 5.0 ppm: Availability coef 0.5
Organic: $N \times 0.50 = 2.5 \text{ mg/L}$
 $2.50 \times 9.05 = 22.62 \text{ mg/L}$
Corn: 0.35 coef
Grain: 0.20 coef

Residual Factor: 0.20

Amount of Available N

203 lb/ac of PRN \times 0.35 = 71.33 lb/ac/yr cover additional 85.90 lb/ac to be supplemental in year 2 on corn. 20% will be residual in soil for plant availability.

Sulfur Loading: 25mg/L SO_4

Drinking water standards secondary allow for 250 mg/L. The sulfur count of the effluent is below that level. Filtrate reaching the ground water system will meet drinking water standards.

Sodium Loading: 250 mg/L

$$\text{Sodium Adsorption Ratio (SAR)} = \frac{\text{NA}^7}{\sqrt{\frac{\text{ca} + \text{mg}}{2}}} = \frac{250}{\sqrt{\frac{620 + 30}{2}}} = \frac{250}{10.95} = 22.83$$

Application of Gypsum is indicated.

Rates of applications will be determined by soil tests following first year application.

Total Oxygen Demand (TOD):

$$\text{COD} = 70 \text{ mg/L} + \text{BOD } 30 \text{ mg/L}$$

$$100 (9.05) = 905 \text{ lb/ac/yr}$$

Soil is similar to State and Tetoum and would have a weekly loading potential which is greater than annual loading rate.

Attachment 3
Site Life Analysis

Site Life Analysis

Nickle	0.005 mg/L $0.005 \times 9.05 = 0.04525 \text{ lb/ac/yr}$ Site life $44/0.4525 = 972 \text{ years}$
Copper	0.01 mg/L $0.01 \times 9.05 = 0.0905 \text{ lb/ac/yr}$ Site life $111/0.0905 = 1226 \text{ years}$
Zinc	0.1 mg/L $0.1 \times 9.05 = 0.905 \text{ lb/ac/yr}$ Site life $222/0.905 = 245 \text{ years}$
Lead	0.02 mg/L $0.02 \times 9.05 = 0.181 \text{ lb/ac/yr}$ Site life $445/0.181 = 2453 \text{ years}$
Cadmium	0.002 $0.002 \times 9.05 = 0.0181$ Site life $2.22/0.0181 = 122.65 \text{ years}$
Boron	1.0 ppm $1.0 \times 9.05 = 905 \text{ lb/ac/yr}$

Boron is essential for plant growth and is required for most plants. Available data indicates that corn removes 0.5 - 1.0 lb/of. boron per acre/year. Available information also indicates that acceptable levels of boron in leachate are 0.75 to 2.0 mg/L. Concentrations of 1.0 mg/L are rational.

Maximum application rate allowable: 2 inches/week and 1 inch/day and 1/4 inch/hour

Final determination will be made when hydraulic conductivity, and infiltration test are complete.
Ksat must be 0.2 - 6 in/hr

Soil saturation will be moistened by installation of tensiometers to determine soil moisture prior to irrigation of dry field.

Tensiometers read centibars of tension. When reading are < 10 centibars- do not irrigate. When > 20 centibars irrigate until approximately 10 centibars level, but not more than 1 inch/day.

Fields should not be irrigated five to six days prior to harvesting crops.

GEOTECHNICAL ENGINEERING STUDY BY AGS

LETTER OF TRANSMITTAL

Hatcher-Sayre

A Duffield Company

905 Southlake Boulevard

Richmond, VA 23236

Phone: 804.794.0216

Fax: 804.379.8934

DATE: 9/5/01

JOB NO.: _____

ATTN: Tom Saylor

RE: Westmoreland

TO: Tom Saylor, Earth Tech

WE ARE SENDING YOU:

- ☐ Concrete Reports ☐ Change Order ☐ Samples ☐ Prints
☐ Specification ☐ Copy of Letter ☐ Shop Drawing
☐ OTHER: Bracing Logs

VIA: ☒ Regular Mail ☐ Overnight Delivery ☐ Hand Delivery ☐ Facsimile ☐ Pick Up

COPIES	DATE	NO.	DESCRIPTION

THESE ARE TRANSMITTED as checked:

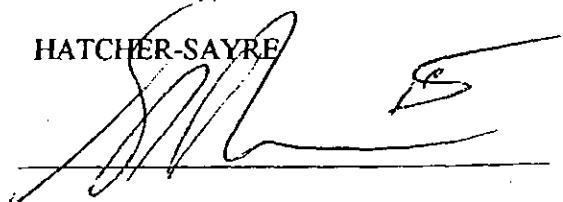
- ☒ For your use ☐ For your approval ☐ As requested ☐ For review and comment

REMARKS:

Tom attached are the work logs for Westmoreland County. When are we at the field work? Let me hear, pls.

COPY TO: _____

HATCHER-SAYRE



DUFFIELD ASSOCIATES, INC.
Consultants in the Geosciences

**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/11/00

LOGGED BY: SLK

<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-1	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.3 - 0.6	Very dark grayish brown (10YR 3/2), Silt loam, trace roots (somewhat friable)
	0.6 - 2.5	Light gray (2.5Y 7/2), Silty clay loam, trace roots (damp) (mottled) (low to medium plasticity) (little fine sand and moist at 2.0 to 2.5 feet)
	2.5 - 4.0	Light brownish gray (2.5Y 6/2), Sandy loam (wet) (mottled) (trace gravel at 3.5 to 4.0 feet)
	4.0 - ...	Brownish yellow (10YR 6/8), Sandy clay loam, trace to little indurated/cemented fragments (wet to moist) (highly mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Water level at 3.0 feet; caved to 4.8 feet at completion.

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**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/11/00

LOGGED BY: SLK

<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-3	0 - 0.5	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.5 - 0.9	Light olive brown (2.5Y 5/4), Silt Loam, trace roots, (somewhat friable)
	0.9 - 2.0	Grayish brown (2.5Y 5/2), Silty clay, trace roots (damp) (mottled) (sticky) low to medium plasticity
	2.0 - 3.0	Pale yellow (2.5Y 7/4), Sandy clay loam, trace gravel (moist to wet) mottled
	3.0 - 4.5	Olive yellow (2.5Y 6/6), Sandy clay loam, some gravel, (wet) (mottled)
	4.5 - ...	Brownish yellow (10YR 6/8), Silty clay loam (highly mottled) medium plasticity

NOTES: (1) Auger terminated at 5.0 feet.
(2) Water level at 3.0 feet; caved to 4.2 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-10	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 2.0	Light yellowish brown (2.5Y 6/4), Silty clay, trace roots, (damp to moist) (highly mottled 1.0 – 2.0 feet) (little to some fine sand 1.5 – 2.0 feet) (low plasticity)
	2.0 - 3.5	Gray (10YR 5/1), Sandy loam, little gravel, trace roots, (wet) (dull mottling)
	3.5 - ...	Grayish brown (2.5Y 5/2), Loamy sand, , little gravel (wet) (dull mottling)

NOTES: (1) Auger terminated at 5.0 feet.

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LOGGED BY: SLK

<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-11	0 - 0.4	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.4 - 0.7	Olive brown (2.5Y 4/4), Silt, trace roots
	0.7 - 2.5	Light brownish gray (2.5Y 6/2), Silty clay, trace gravel, trace roots (low plasticity) (mottled) (little fine to medium sand at 2.0 - 2.5 feet)
	2.5 - ...	Light grayish brown (2.5Y 6/2), Loamy sand, trace gravel (wet) (running sand 4.0 - 5.0 feet ±)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Wet and caved at 4.0 feet.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-12	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.3 - 0.7	Dark grayish brown (10YR 4/2), Silt loam, trace gravel, trace roots
	0.7 - 2.5	Dark grayish brown (2.5Y 4/2), Silty clay, trace gravel, trace roots (low plasticity) (dull mottling) (little to some fine sand at 2.0 - 2.5 feet)
	2.5 - ...	Grayish brown (2.5Y 5/2), Loamy sand, little gravel, (wet at 3.0 - 5.0 feet) (running sand 3.0 - 5.0 feet)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Water level at 4.0 feet; caved to 4.3 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-13	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 0.5	Dark grayish brown (10YR 4/2), Silty loam, trace roots
	0.5 - 2.5	Dark grayish brown (2.5Y 4/2), Silty clay loam, trace roots, trace gravel (low to medium plasticity) (dull mottled)
	2.5 - 4.5	Dark grayish brown (2.5Y 4/2), Sandy loam, little gravel (coarse gravel at 4.0 feet) (moist to wet) (dull mottling)
	4.5 - ...	Light gray (10YR 7/1), Silty clay, trace roots (stiff) (sandy pockets/lenses) highly mottled)

- NOTES: (1) Auger terminated at 5.0 feet.
(2) Bottom at 5.0 feet; water level at 4.0 feet at completions.

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DATE: 12/19/00

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-14	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 1.5	Dark gray (10YR 4/1), Sandy clay loam, trace roots (wet)
	1.5 - 3.0	Gray (10YR 5/1), Sandy loam, trace coarse gravel, trace roots (wet)
	3.0 - ...	Dark Gray (10YR 4/1), sandy loam, trace to little gravel (wet) (trace recovery – sand running out of bucket)

NOTES: (1) Auger terminated at 3.5 feet (no recovery).
(2) In wetland delineated area.

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CLIENT: Resource International, LTD.

DATE: 12/15/00

LOGGED BY: SLK

Hand Auger No.	Depth Range (ft.)	Generalized Soil Description
HA-15	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 1.5	Light gray (10YR 6/1), Silty clay loam, trace roots (moist) (mottled)
	1.5 - 3.5	Grayish brown (2.5Y 5/2), Sandy clay loam, trace coarse gravel, trace roots (moist to wet) (mottled) (little to some clayey silt at 3.0 to 3.5 feet)
	3.5 - 4.5	Light yellowish brown (2.5Y 6/4), Sandy loam, trace medium to coarse gravel, trace roots (wet) (brightly colored) (mottled)
	4.5 - ...	Light gray (10YR 7/1), Loamy sand, little coarse gravel (wet to running sand)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Water level at 2.8 feet; caved at 3.5 feet at completion.

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LOGGED BY: SLK

W.O. No.: 4649.CA.01
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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-16	0 - 0.4	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.4 - 2.0	Grayish brown (10YR 5/2), Silty clay loam, trace roots (slightly mottled) (moist)
	2.0 - 4.0	Light brownish gray (10YR 6/2), Sandy loam, trace gravel, trace roots (wet) (abundant roots at 3.5 feet) (organic odor)
	4.0 - ...	Light gray (10YR 6/1), Sandy loam, little coarse gravel, trace roots (wet) (dull mottling)

NOTES: (1) Auger terminated at 5.0 feet.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-17	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.3 - 2.5	Light gray (10YR 6/1), Silty clay loam, trace roots (mottled) (damp) (little fine sand, trace gravel at 2.0 to 2.5 feet)
	2.5 - 4.0	Gray (10YR 5/1), Sandy loam, little gravel (moist to wet) (dull mottling) (gravel lense at 3.0 ± feet)
	4.0 - ...	Light gray (10YR 7/2), Loamy sand, little gravel (wet)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Water level at 3.3 feet; caved to 3.8 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-18	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.3 - 2.5	Gray (10YR 5/1), Silty clay loam, trace roots (moist) (mottled) (sticky)
	2.5 - 4.0	Dark gray (10YR 4/1), Sandy loam, little coarse gravel (wet) (dull mottling)
	4.0 - ...	Brownish yellow (10YR 6/8), Silty clay loam, trace roots (wet) (highly mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Bottom at 5.0 feet; water level at 2.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-19	0 - 0.1	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.1 - 2.0	Light yellowish brown (2.5Y 6/4), Silty clay loam, trace roots (damp) (dull mottling)
	2.0 - 4.3	Light brownish gray (2.5Y 6/2), Sandy loam, little gravel (moist to wet) (mottled) (more yellow and brownish yellow color at 3.5 to 4.3 feet)
	4.3 - . . .	Brownish yellow (10YR 6/8), Silty clay loam, trace gravel, trace indurated/cemented fragments (wet) (highly mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Bottom at 5.0 feet; water level at 3.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-20	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 2.0	Gray (10YR 5/1), Silty clay loam, trace roots, (damp) (medium stiff) (mottled)
	2.0 - 3.8	Dark grayish brown (10YR 4/2), Sandy loam, little coarse gravel, (moist) (dull mottling)
	3.8 - ...	Light gray (10YR 7/1), Silty clay loam, trace roots, trace indurated/cemented fragments (highly mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Bottom at 5.0 feet; water level at 3.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-21	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.3 - 2.0	Gray (10YR 5/1), Silty clay loam, trace roots (wet at 2.0 feet) (mottled)
	2.0 - 2.5	Gray (10YR 5/1), Sandy clay loam, trace to little gravel, trace roots (wet) (dull mottling)
	2.5 - 4.5	Dark grayish brown (10YR 4/2), Sandy loam, trace to little gravel (wet) (dull mottling) (more yellow and yellowish-brown color at 4.0 - 4.5 feet)
	4.5 - ...	Yellowish brown (10YR 5/6), Silty clay loam, trace indurated/cemented fragments, trace roots, trace gravel (wet) (highly mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Bottom at 5.0 feet; water level at 1.9 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-22	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 3.0	Dark gray (10YR 4/1), Silty clay, trace roots (wet) (mottled) (little fine sand 2.0 to 3.0 feet)
	3.0 - 4.0	Brownish yellow (10YR 6/8), Sandy loam, trace gravel (wet) (mottled) (little to some silty clay 3.5 to 4.0 feet)
	4.0 - ...	Dark gray (10YR 4/1), Silty clay, trace indurated/cemented fragments (wet) (mottled)

NOTES: (1) Auger terminated at 5.0 feet.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-23	0 - 0.4	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.4 - 2.5	Light olive brown (2.5Y 5/4), Silty clay loam, trace roots, trace gravel (moist) (dull mottling) (little to some fine sand 2.0 to 2.5 feet)
	2.5 - 3.5	Grayish brown (2.5Y 5/2), Sandy loam, little to trace coarse sand/gravel (wet) (dull mottling)
	3.5 - . . .	Brownish yellow (10YR 6/8), Silty clay loam, trace indurated/cemented fragments, trace roots (wet) (brightly mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Water level at 3.3 feet; bottom at 5.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-24	0 - 0.4	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.4 - 1.0	Olive brown (2.5Y 4/4), Silty clay loam, trace roots, (moist)
	1.0 - 2.0	Light olive brown (2.5Y 5/6), Silty clay loam, trace roots, trace gravel (damp)
	2.0 - 3.0	Light olive brown (2.5Y 5/4), Silty clay loam, trace roots (dull mottling) (moist to wet)
	3.0 - 3.5	Dark grayish brown (2.5Y 4/2), Sandy loam, trace to little coarse gravel (wet) (mottled)
	3.5 - ...	Brownish yellow (10YR 6/8), Silty clay loam (wet) highly mottled) (trace to little fine sand 4.5 to 5.0 feet)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Water level at 3.5 feet; bottom at 5.0 feet at completion.

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DATE: 12/19/00

LOGGED BY: SLK

<u>GeoProbe No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-25	0.0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 2.0	Dark grayish brown (10YR 4/2), Silty clay, trace roots (moist) (highly mottled) (medium to low plasticity)
	2.0 - 4.0	Gray (10YR 5/1), Sandy loam, trace gravel (wet) (mottled)
	4.0 - 4.5	Yellow (10YR 7/8), Loamy sand, some coarse gravel, trace roots (wet) (mottled)
	4.5 - 5.0	Yellowish brown (10YR 5/6), Sandy loam, little indurated/cemented fragments, trace coarse gravel, trace roots (wet) (brightly mottled)

- NOTES: (1) Boring hole terminated at 5.0 feet.
(2) Water level at 1.0 foot; cave to 3.5 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-26	0 - 0.1	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.1 - 1.5	Olive brown (2.5Y 4/4), Silty clay loam, trace roots (damp) (increasing mottling with depth)
	1.5 - 2.5	Yellowish brown (10YR 5/6), Silty clay, trace roots (moist to wet) (mottled)
	2.5 - 4.5	Dark grayish brown (10YR 4/2), Sandy loam, some coarse gravel, trace roots (wet)
	4.5 - ...	Light gray (10YR 7/1), Silty clay, trace coarse gravel, trace roots (wet) (brightly colored) (mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Water level at 1.3 feet; bottom at 5.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-27	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.3 - 2.0	Light olive brown (2.5Y 5/4), Silty clay, trace roots, trace gravel (moist) (slight mottled)
	2.0 - 2.5	Gray (10YR 5/1), Sandy clay loam, trace coarse gravel, trace roots (moist) (dull mottling)
	2.5 - 4.0	Yellowish brown (10YR 5/4), Loamy sand, little to some gravel, trace roots (wet) (dull mottling) (more brownish yellow color at 4.0 feet ±)
	4.0 - ...	Brownish yellow (10YR 6/8), Silty clay (wet) (mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Water level at 2.2 feet; caved at 2.8 feet at completion.

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**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/14/00

LOGGED BY: SLK

<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-28	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 1.0	Dark brown (10YR 3/3), Silty clay loam, trace to little gravel, trace roots
	1.0 - 3.5	Light yellowish brown (2.5Y 6/4), Silty clay loam, trace roots, trace gravel (moist) (dull mottling)
	3.5 - 4.0	Light brownish gray (2.5Y 6/2), Sandy clay loam (moist) (mottled)
	4.0 - ...	Light gray (10YR 6/1), silty clay loam, trace roots (moist) (highly mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Water level at 4.7 feet; bottom at 5.0 feet at completion.

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PROJECT: Coles Point Spray Irrigation

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-29	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 2.5	Yellowish brown (10YR 5/4), Silty clay loam, trace gravel, trace roots (friable 0.2 to 1.5 ± feet)
	2.5 - 3.5	Grayish brown (10YR 5/2), Silty clay loam, trace gravel (moist) (mottled)
	3.5 - . . .	Pale brown (10YR 6/3), Sandy loam, trace to little indurated/cemented fragments, trace roots (moist to wet) (highly mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Water level at 4.7 feet; bottom at 5.0 feet at completion.

DUFFIELD ASSOCIATES, INC.
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**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-30	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers (sandy)
	0.3 - 2.0	Yellowish brown (10YR 5/4), Silt loam, trace gravel, trace roots (friable) (gravely lense at 1.5 ± feet)
	2.0 - 3.0	Yellowish brown (10YR 5/6), Sandy loam, trace gravel, trace roots (low plasticity) (slightly mottled)
	3.0 - 4.5	Yellowish brown (10YR 5/8), Silty clay loam, trace indurated/cemented fragments, trace roots (low plasticity) (mottled)
	4.5 - ...	Brownish yellow (10YR 6/8), Silty clay loam, trace roots (mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Dry and open to 5.0 feet at completion.

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DESCRIPTIVE LOG**

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-31	0 - 0.5	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.5 - 2.8	Grayish brown (2.5Y 5/2), Silty clay loam, trace gravel, trace roots (mottled 1.0 to 2.8 feet) (low to medium plasticity)
	2.8 - 4.0	Gray (10YR 5/1), Sandy loam, little coarse gravel, trace roots (moist) (mottled)
	4.0 - ...	Light gray (10YR 6/1), Silty clay loam, trace coarse gravel (moist to wet) (mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Dry and open to 5.0 feet at completion.

DUFFIELD ASSOCIATES, INC.
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**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation
CLIENT: Resource International, LTD.
LOGGED BY: SLK

W.O. No.: 4649.CA.01
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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-32	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 0.5	Light olive brown (2.5Y 5/6), silty clay loam, abundant roots
	0.5 - 1.5	Light olive brown (2.5Y 5/4), Sandy loam, trace gravel, trace roots (slightly mottled 1.0 to 1.5 feet)
	1.5 - 2.5	Brownish yellow (10YR 6/8), Sandy loam, trace gravel, trace roots (1.0 to 1.5 feet)
	2.5 - 3.0	Brownish yellow (10YR 6/6), Silty clay, trace roots (mottled) (low to medium plasticity)
	3.0 - ...	Brownish yellow (10YR 6/8), Silty clay, trace roots trace indurated/cemented fragment) (highly mottled) (possible saturated 4.5 to 5.0 feet)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Water level at 4.8 feet; bottom at 5.0 feet at completion.

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**HAND AUGER
DESCRIPTIVE LOG**

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W.O. No.: 4649.CA.01
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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-33	0 - 0.1	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.1 - 1.0	Light olive brown (2.5Y 5/6), Silty clay loam (moist) (slightly mottled) (soft)
	1.0 - 2.0	Dark gray (10YR 4/1), Sandy loam, trace gravel, trace roots, trace possible shell fragments (wet) (mottled)
	2.0 - 2.5	Dark gray (10YR 4/1), Sandy loam, some gravel, trace roots (wet)
	2.5 - ...	Brownish yellow (10YR 6/8), silty clay (possible saturated) (highly mottled)

NOTES: (1) Auger terminated at 4.0 feet due to clay (impervious lense).
(2) Water level at 1.3 feet; bottom at 4.0 feet at completion.
(3) Approximate 6 feet east of creek.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-34	0 - 0.1	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.1 - 1.5	Very dark grayish brown (2.5Y 3/2), Silty clay loam (abundant roots 0.1 to 0.8 feet) (trace roots 0.8 to 1.5 feet) (slight brownish yellow mottling 0.8 - 1.5 feet) (soft) (moist)
	1.5 - 2.2	Dark grayish brown (10YR 4/2), Silty clay loam, trace coarse gravel, trace roots, (mottled) (moist to wet) (groundwater observed at 2.0 feet with bottom at 2.2 feet)
	2.2 - 3.5	Yellowish brown (10YR 5/4), Sandy loam, some fine gravel, organic roots (wet)
	3.5 - ...	Yellowish brown (10YR 5/6), Silty clay (highly mottled) (possible saturated)

NOTES: (1) Auger terminated at 5.0 feet.

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DATE: 12/13/00

LOGGED BY: SLK

<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-35	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 1.8	Light olive brown (2.5Y 5/6), Silty clay loam, trace roots (slightly mottled) (low to medium plasticity)
	1.8 - 3.0	Gray (10YR 5/1), Sandy loam, trace roots (damp) (dull mottling)
	3.0 - ...	Light gray (10YR 7/1), Silty clay loam, trace roots (trace gravel at 3.0 ± feet) (moist 3.0 to 4.0 feet) (wet 4.0 to 5.0 feet) (mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Muddy and open to 5.0 feet at completion.

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LOGGED BY: SLK

<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-36	0 - 0.5	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.5 - 2.4	Light olive brown (2.5Y 5/4), Silty clay loam, trace roots
	2.4 - 3.5	Dark yellowish brown (10YR 4/4), Sandy loam, trace to little gravel (damp) (dull mottling)
	3.5 - ...	Brownish yellow (10YR 6/8), Sandy loam, trace gravel, trace roots (moist) (mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Dry and open to 5.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-37	0 - 0.7	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.7 - 2.5	Yellowish brown (10YR 5/4), Silty loam, trace gravel, trace roots
	2.5 - 4.0	Yellowish brown (10YR 5/6), Silty clay loam, trace gravel, trace roots (dull mottling)
	4.0 -	Brownish yellow (10YR 6/8), Silty clay loam, trace roots (damp to moist) (highly mottled) (low to medium plasticity)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Dry and open to 5.0 feet at completion.

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DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/12/00

LOGGED BY: SLK

<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-38	0 - 0.4	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.4 - 1.5	Light olive brown (2.5Y 5/6), Sandy loam, trace roots (damp)
	1.5 - 2.5	Light olive brown (2.5Y 5/6), Silty clay loam, trace roots (damp)
	2.5 - 4.2	Yellowish brown (10YR 5/8), Sandy loam, trace gravel, trace roots (moist) (mottled)
	4.2 - ...	Light gray (10YR 7/2), Sandy loam, trace roots (wet) (mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Dry and open to 5.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-39	0 - 0.4	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.4 - 1.5	Olive brown (2.5Y 4/4), Sandy loam, trace roots
	1.5 - 3.0	Dark yellowish brown (10YR 4/6), Sandy loam, trace gravel (damp)
	3.0 - 4.0	Dark yellowish brown (10YR 4/4), Sandy loam (damp to moist) (mottled)
	4.0 - ...	Brownish yellow (10YR 6/6), Sandy loam (moist) (highly mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Dry and open to 5.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-40	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 0.7	Olive brown (2.5Y4/4), Silty loam, trace roots
	0.7 - 3.0	Yellowish brown (10YR 5/6), Silty clay loam, trace gravel, trace roots
	3.0 - 4.0	Yellowish brown (10YR 5/6), Silty clay loam, trace roots (slightly mottled)
	4.0 - ...	Yellowish brown (10YR 5/8), Silty clay loam, trace roots (mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Dry and open to 5.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-41	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.3 - 2.7	Very dark grayish brown (2.5Y 3/2), Silty clay loam, trace gravel, trace roots
	2.7 - 4.0	Light brownish gray (10YR 6/2), Silty clay loam, trace vegetative fibers (moist) (highly mottled)
	4.0 - ...	Light brownish gray (10YR 6/2), Silty clay loam, little coarse gravel, trace roots (trace dark red brown, black blotches/pockets) (moist) (highly mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Dry and open to 5.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-42	0 - 0.4	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.4 - 1.5	Light olive brown (2.5Y 5/6), Sandy loam, trace roots, trace gravel
	1.5 - 2.5	Pale brown (10YR 6/3), Sandy loam, little to trace gravel
	2.5 - 4.0	Light brownish gray (10YR 6/2), Loamy sand, trace to little gravel, (olive brown clayey silt and fine sand balls/pockets at 3.5 to 4.0 ± feet)
	4.0 - ...	Brownish yellow (10YR 6/6), Silty clay loam, trace roots (moist to damp) (highly mottled 4.5 to 5.0 feet)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Dry and open to 5.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-43	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers (sandy)
	0.3 - 1.0	Light olive brown (2.5Y 5/6), Sandy loam, trace roots (friable)
	1.0 - 2.0	Brownish yellow (10YR 6/8), Sandy loam
	2.0 - 3.0	Brownish yellow (10YR 6/6), Sandy loam, trace to little gravel
	3.0 - 3.5	Light yellowish brown (10YR 6/4), Sandy loam, trace to little gravel
	3.5 - 4.5	Light yellowish brown (10YR 6/4), Sandy loam, (mottled)
	4.5 - ...	Light yellowish brown (10YR 6/4), Sandy loam, (damp) (highly mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Dry and open to 5.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-44	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers (sandy)
	0.3 - 1.0	Light olive brown (2.5Y 5/6), Sandy loam, trace roots (friable)
	1.0 - 2.3	Brownish yellow (10YR 6/8), Sandy loam, trace gravel, trace roots
	2.3 - 3.5	Yellowish brown (10YR 5/8), Sandy loam, little gravel, trace roots
	3.5 - 4.5	Light olive brown (2.5Y 5/6), Sandy loam, (damp) (mottled)
	4.5 - ...	Brownish yellow (10YR 6/6), Sandy loam (moist)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Dry and open to 5.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-45	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.3 - 1.5	Olive yellow (2.5Y 6/6), Silt loam, trace roots (friable)
	1.5 - 3.5	Olive yellow (2.5Y 6/6), Sandy loam, little gravel
	3.5 - 4.0	Brownish yellow (10YR 6/8), Silty clay, trace medium sand, trace roots (mottled) (low to medium plasticity)
	4.0 - ...	Light gray (10YR 7/1), Silty clay, trace roots (mottled) (medium high plasticity)

NOTES: (1) Auger terminated at 5.0 feet.
(2) Dry and open to 5.0 feet at completion.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-P-1	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 1.8	Olive brown (2.5Y 4/4), Silty clay loam, trace roots (moist) (slightly mottled 1.0 to 1.8 feet)
	1.8 - 2.0	Light olive brown (2.5Y 5/4), Sandy loam (wet to moist) slightly mottled)
	2.0 - 4.8	Light brownish gray (2.5Y 6/2), Sandy loam (trace gravel at 4.0 feet) (wet) (slightly mottled)
	4.8 - ...	Brownish yellow (10YR 6/8), Silty clay (highly mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) One-inch observation well installed in borehole.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-P-2	0 - 0.1	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 2.0	Light olive brown (2.5Y 5/4), Silty clay loam, trace roots (moist) (slightly mottled)
	2.0 - 3.8	Light brownish gray (2.5Y 6/2), Sandy loam (wet) (slightly mottled) (gravel at 3.7 ± feet)
	3.8 - ...	Light gray (10YR 7/1), Loamy sand, some gravel (mottled)

NOTES: (1) Auger terminated at 5.0 feet.
(2) One-inch observation well installed in borehole.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-P-3	0 - 0.1	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.1 - 3.0	Light olive brown (2.5Y 5/4), Silty clay loam, trace roots (moist) (mottled at 1.5 to 3.0 feet)
	3.0 - ...	Light brownish gray (2.5Y 6/2), Sandy loam (wet) (mottled) (brightly colored 3.5 to 5.0 feet)

NOTES: (1) Auger terminated at 5.0 feet.
(2) One-inch observation well installed in borehole.

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<u>Hand Auger No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
HA-P-4	0 - 0.1	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.1 - 1.2	Light olive brown (2.5Y 5/4), Silt, trace roots, (somewhat friable 0.1 to 1.0 feet) (mottled at 1.0 to 1.2 feet)
	1.2 - 2.2	Light brownish gray (2.5Y 6/2), Silty clay loam (mottled) (low plasticity) (some fine sand 1.7 to 2.2 feet)
	2.2 - 3.5	Light yellowish brown (2.5Y 6/4), Sandy loam, little gravel (moist to wet) (mottled) (coarse gravel 2.7 to 4.0 feet)
	3.5 - ...	Light gray (10YR 7/1), Sandy loam, trace gravel (moist to wet) (mottled) (sandy at 5.0 feet)

- NOTES: (1) Auger terminated at 5.0 feet.
(2) One-inch observation well installed in borehole.
(3) Boring offset 10 ± feet due to refusal at 4.0 feet due to coarse gravel.

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LOGGED BY: SLK

<u>GeoProbe No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
G-P-5	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 2.5	Olive brown (2.5Y 4/4), Silty clay loam, trace roots, trace gravel (mottled)
	2.5 - 4.0	Light gray (10YR 7/1), silty clay loam, trace gravel, trace roots (low to medium plasticity) (mottled)
	4.0 - 5.0	Light gray (10YR 7/1), Silty clay loam, trace gravel, trace roots with little cemented fragments (moist to wet) (mottled)
	5.0 - 7.5	Brownish yellow (10YR 6/6), Silty clay loam, trace indurated/cemented fragments (silty lenses) (moist to wet)
	7.5 - ...	Grayish brown (10YR 5/2), Silty clay (medium to high plasticity)

NOTES: (1) Boring hole terminated at 8.0 feet.
(2) Offset due to excessive vegetation.
(3) P-5 installed in borehole.

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DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/8/00

LOGGED BY: SLK

<u>GeoProbe No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
G-P-6	0 - 0.7	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.7 - 1.5	Dark brown (10YR 3/3), Sandy loam, little gravel size cemented fragments (possible iron stone) (damp)
	1.5 - 3.0	Light gray (10YR 7/1), Silty clay, trace cemented fragments (mottled) (some fine sand 2.5 to 3.0 feet)
	3.0 - ...	Light gray (10YR 7/1), Loamy sand, trace gravel (gravely lense at 3.0 feet \pm) (moist)

NOTES: (1) Borehole terminated at 9.0 feet. Heave at 7.0 feet \pm .
(2) Piezometer P-6 installed in borehole.

DUFFIELD ASSOCIATES, INC.
Consultants in the Geosciences

**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/8/00

LOGGED BY: SLK

<u>GeoProbe No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
G-P-7	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.3 - 2.5	Olive brown (2.5Y 4/4), Silty clay, trace coarse gravel (damp to moist, mottled) (gravely lense at 2.5 ± feet)
	2.5 - 9.0	Light gray (10YR 7/1), Silty clay, trace vegetative fibers (mottled, medium to high plasticity)
	9.0 - 10.0	Yellow (10YR 7/8), Silty clay, little cemented soil fragments
	10.0 - ...	Gray (10YR 6/1), Silty clay (inter bedded)

NOTES: (1) Borehole terminated at 15.0 feet.
(2) Piezometer P-7 installed in borehole.

DUFFIELD ASSOCIATES, INC.
Consultants in the Geosciences

**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/8/00

LOGGED BY: SLK

<u>GeoProbe No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
G-P-8	0 - 0.4	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.4 - 1.5	Olive brown (2.5Y 4/4), Silty clay loam, trace vegetative fiber (damp, mottled, little to some fine sand 1.2 to 1.5 feet \pm)
	1.5 - 6.0	Light gray (10YR 7/1), Sandy loam, trace gravel, trace vegetative fibers (wet, mottled)
	6.0 - ...	Brownish yellow (10YR 6/6), Loamy sand (wet)

NOTES: (1) Borehole terminated at 10.0 feet. Heaved at 7.1 feet \pm .
(2) Piezometer P-8 installed in borehole.

DUFFIELD ASSOCIATES, INC.
Consultants in the Geosciences

**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/7/00

LOGGED BY: SLK

<u>GeoProbe No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
G-P-9	0 - 0.2	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.2 - 2.0	Gray (10YR 6/1), Silty clay loam, trace roots
	2.0 - 5.0	Brown (10YR 5/3), Sandy loam, trace gravel (moist)
	5.0 - 7.0	Yellow (10YR 7/6), Silt loam (moist to wet, mottled)
	7.0 - ...	Pale brown (10YR 6/3), Loamy sand

NOTES: (1) Borehole terminated at 10.0 feet due to heaved/caved to 7.5 feet ±.
(2) Piezometer P-9 installed in borehole.

DUFFIELD ASSOCIATES, INC.
Consultants in the Geosciences

**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/7/00

LOGGED BY: SLK

<u>GeoProbe No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
G-P-10	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.3 - 2.0	Brown (10YR 5/3), Silty clay loam (damp, mottled)
	2.0 - 5.0	Light brownish gray (10YR 6/2), Sandy loam (moist)
	5.0 - ..	Brownish yellow (10YR 6/6), Silty clay loam, trace gravel, trace roots (moist to wet, lense with little cemented soil fragments 5.0 to 6.0 feet)

- NOTES: (1) Wet on rods at 6.5 feet.
(2) Borehole terminated at 12.0 feet.
(3) Piezometer P-10 installed in borehole.

DUFFIELD ASSOCIATES, INC.
Consultants in the Geosciences

**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/7/00

LOGGED BY: SLK

<u>GeoProbe No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
G-P-11	0 - 0.4	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers (sandy)
	0.4 - 1.5	Olive brown (2.5Y 4/4), Silt loam, trace roots (damp)
	1.5 - 4.0	Light brownish gray (10YR 6/2), Sandy loam (moist) (yellow and light gray at 5.0 to 6.0 feet)
	4.0 - 6.0	(Moist to wet at 5.0 to 6.0 feet)
	6.0 - 8.0	Light gray (10YR 7/1), Silty clay loam, little indurated/cemented fragments (moist to wet)
	8.0 - 10.5	SAME (Mottled and wet at 10.0 to 10.5 ± feet)
	10.5 - ...	Dark gray (10YR 4/1), Silty clay loam (low plasticity) (sand and gravel lense at 11.5 to 11.6) (thin lenses of fine sand)

NOTES: (1) Borehole terminated at 12.0 feet.
(2) Piezometer P-11 installed in borehole.

DUFFIELD ASSOCIATES, INC.
Consultants in the Geosciences

**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/6/00

LOGGED BY: SLK

<u>GeoProbe No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
G-P-12	0 - 0.4	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt loam, and abundant root fibers
	0.4 - 1.5	Light yellowish brown (10YR 6/4), Silty clay loam
	1.5 - 5.0	Light yellowish brown (10YR 6/4), Sandy loam, trace gravel
	5.0 - 11.0	Yellow (10YR 7/6), Silt loam, trace gravel, trace cemented soil fragments (moist, mottled)
	11.0 - 13.0	Light brownish gray (10YR 6/2), Silty clay, trace cemented iron stone (thin stringers inter bedded into silty clay, stiff)
	13.0 - ...	Dark gray (10YR 4/1), Clay (very stiff)

NOTES: (1) Borehole terminated at 15.0 feet.
(2) Piezometer P-12 installed in borehole.

DUFFIELD ASSOCIATES, INC.
Consultants in the Geosciences

**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/6/00

LOGGED BY: SLK

<u>GeoProbe No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
G-P-13	0 - 0.5	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.5 - 3.5	Brownish yellow (10YR 6/8), Silty clay, trace gravel, trace roots, (slightly mottled)
	3.5 - 5.5	Light brownish gray (2.5Y 6/2), Sandy loam
	5.5 - 11.0	Brownish yellow (10YR 6/8), Silty clay (lense with cemented soil fragments at 6.0 to 6.5 feet \pm)
	11.0 - 11.5	Light yellowish brown (10YR 6/4), Loamy sand, cemented sand lense, trace gravel
	11.5 - ...	Dark gray (10YR 4/1), Clay (stiff)

NOTES: (1) Borehole terminated at 15.0 feet.
(2) Piezometer P-13 installed in borehole.

DUFFIELD ASSOCIATES, INC.
Consultants in the Geosciences

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DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/7/00

LOGGED BY: SLK

<u>GeoProbe No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
G-P-14	0 - 0.4	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers
	0.4 - 3.0	Olive brown (2.5Y 4/4), Silt loam
	3.0 - 5.5	Brown (10YR 5/3), Sandy loam, trace gravel (moist at 5.0 feet)
	5.5 - 7.0	Brownish yellow (10YR 6/6), Sandy loam (moist)
	7.0 - 11.5	Yellowish brown (10YR 5/8), Silty clay, cemented soil fragments (mottled)
	11.5 - ...	Brownish yellow (10YR 6/8), Sandy loam, trace gravel (wet)

NOTES: (1) Borehole terminated at 15.0 feet.
(2) Piezometer P-14 installed in borehole.

DUFFIELD ASSOCIATES, INC.
Consultants in the Geosciences

**HAND AUGER
DESCRIPTIVE LOG**

PROJECT: Coles Point Spray Irrigation

W.O. No.: 4649.CA.01

CLIENT: Resource International, LTD.

DATE: 12/7/00

LOGGED BY: SLK

<u>GeoProbe No.</u>	<u>Depth Range (ft.)</u>	<u>Generalized Soil Description</u>
G-P-15	0 - 0.3	Dark brown (10YR 3/3), decomposing leaves and vegetative material, Silt and abundant root fibers (sandy)
	0.3 - 3.0	Brown (10YR 5/3), Silt loam
	3.0 - 4.0	Brown (10YR 5/3), Loamy sand
	4.0 - 12.0	Light gray (10YR 7/1), Silty clay loam, trace indurated/cemented fragments (thin sandy lenses) (moist) (highly mottled) (low to medium plasticity) (sand and gravel lense 11.0 to 11.3 ± feet) (wet)
	12.0 - 15.5	Light brownish gray (10YR 6/2), Silty clay (medium stiff) (sandy lenses) (mottled)
	15.5 - ...	Dark gray (10YR 4/1), Silty clay (stiff) (medium plasticity)

NOTES: (1) Boring hole terminated at 16.0 feet.
(3) P-15 installed in borehole.

Appendix B

Laboratory Analytical Results

REPORT NUMBER

R355-100

A&L EASTERN AGRICULTURAL LABORATORIES, INC.

7621 Whitepine Road • Richmond, Virginia 23237 • (804) 743-9401

Fax No. (804) 271-6446



ACCT # 70892

SEND HATCHER-SAYRE INC
TO:WESTMORELAND
GROWER: 0957-002

SAMPLES

SUBMITTED HATCHER-SAYRE INC
BY:905 SOUTHLAKE BLVD
RICHMOND VA 23236DATE RECEIVED 12/19/2000
DATE OF ANALYSIS 12/20/2000

12/20/2000 PAGE 1 SOIL ANALYSIS REPORT

DATE OF REPORT

SAMPLE NUMBER	LAB NUMBER	ORGANIC MATTER		PHOSPHORUS		POTASSIUM		MAGNESIUM		CALCIUM		SODIUM		pH		ACIDITY		C.E.C. meq/100g
		%	ENR lbs./A	BRAY P1 ppm	BRAY P2 ppm	K ppm	MG ppm	CA ppm	NA ppm	SOIL pH	BUFFER INDEX	H meq/100g						
15458	01103	0.7	60VL	8 VL	10 VL	28 L	32 L	290 M	6 VL	5.2	6.84	0.9	2.8					
15459	01104	0.9	62L	6 VL	8 VL	24 VL	35 L	250 VL	8 VL	5.2	6.65	2.8	4.4					
15460	01105	0.6	56VL	10 L	15 L	29 VL	44 L	220 VL	8 VL	4.9	6.65	2.8	4.4					
15461	01106	0.3	47VL	5 VL	7 VL	30 VL	41 VL	210 VL	8 VL	4.7	6.44	4.9	6.4					
15462	01107	0.7	49VL	9 L	18 L	38 VL	28 VL	60 VL	11 VL	4.4	5.98	9.5	10.2					

SAMPLE NUMBER	PERCENT BASE SATURATION					NITRATE		SULFUR		ZINC		MANGANESE		IRON		COPPER		BORON		SOLUBLE SALTS		CHLORIDE		MOLYB- DENUM ppm
	K %	Mg %	Ca %	Na %	H %	NO ₃ -N ppm	SO ₄ -S ppm	ZN ppm	MN ppm	FE ppm	CU ppm	B ppm	CL ppm	CL ppm	CL ppm	CL ppm	CL ppm	CL ppm	CL ppm	CL ppm	CL ppm			
15458	2.6	9.7	52.6	0.9	34.1		23 VH					0.2 VL	16 L											
15459	1.4	6.6	28.2	0.8	63.1		22 VH					0.2 VL	13 L											
15460	1.7	8.4	25.1	0.8	64.0		35 VH					0.2 VL	15 L											
15461	1.2	5.3	16.4	0.5	76.5		43 VH					0.2 VL	15 L											
15462	1.0	2.3	2.9	0.5	93.3		48 VH					0.2 VL	5 L											

Values on this report represent the plant available nutrients in the soil.

Explanation of symbols: Values are expressed as % (percent), ppm (parts per million), or lbs/A (pounds per acre).

Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High).

ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

This report applies to the sample(s) tested. Samples are retained a maximum of thirty days after testing. Soil Analysis prepared by:

A&L EASTERN AGRICULTURAL LABORATORIES, INC.

D. NORMAN JONES

REPORT NUMBER
R355-100

A&L EASTERN AGRICULTURAL LABORATORIES, INC.
7621 Whitepine Road • Richmond, Virginia 23237 • (804) 743-9401
Fax No. (804) 271-6446



ACCT # 70892

SEND HATCHER-SAYRE INC
TO:

GROWER: WESTMORELAND
0957-002

SAMPLES
SUBMITTED BY:

HATCHER-SAYRE INC

DATE RECEIVED 12/19/2000
DATE OF ANALYSIS 12/20/2000

SOIL ANALYSIS REPORT

DATE OF REPORT 12/20/2000 PAGE 2

SAMPLE NUMBER	LAB NUMBER	ORGANIC MATTER		PHOSPHORUS		POTASSIUM		MAGNESIUM		CALCIUM		SODIUM		pH		ACIDITY	C.E.C.
		%	ENR lbs./A	BRAY P1 ppm	RATE	BRAY P2 ppm	RATE	K ppm	RATE	MG ppm	RATE	CA ppm	RATE	NA ppm	SOIL pH	BUFFER INDEX	H meq/100g
15463	01108	0.2	47VL	5 VL	7 VL		24 VL	27 VL		60 VL		11 VL	4.3	6.53		4.0	4.6
15464	01109	1.1	51VL	5 VL	8 VL		42 VL	24 VL		70 VL		11 VL	4.3	5.54		13.9	14.6
15465	01110	0.2	51VL	3 VL	5 VL		24 VL	21 L		70 VL		10 VL	4.4	6.78		1.5	2.1

SAMPLE NUMBER	PERCENT BASE SATURATION				NITRATE	SULFUR	ZINC	MANGANESE	IRON	COPPER	BORON	SOLUBLE SALTS		CHLORIDE		MOLYB
	K %	Mg %	Ca %	Na %	H %	NO ₃ -N ppm	SO ₄ -S ppm	ZN ppm	MN ppm	FE ppm	CU ppm	B ppm	ms/cm RATE	ppm	RATE	ppm
15463	1.3	4.9	6.5	1.0	86.3		31 VH					0.2 VL	<.3 VL	10		
15464	0.7	1.4	2.4	0.3	95.2		34 VH					0.2 VL	<.3 VL	16		
15465	2.9	8.2	16.4	2.0	70.4		20 VH					0.2 VL	<.3 VL	14		

Values on this report represent the plant available nutrients in the soil.

Explanation of symbols: Values are expressed as % (percent), ppm (parts per million), or lbs/A (pounds per acre).

Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High).

ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

This report applies to the sample(s) tested. Samples are retained a maximum of thirty days after testing. Soil Analysis prepared by:

A & L EASTERN AGRICULTURAL LABORATORIES, INC.

NORMAN JONES

REPORT NUMBER:
R355-100

A&L EASTERN AGRICULTURAL LABORATORIES, INC.

7621 Whitepine Road • Richmond, Virginia 23237 • (804) 743-9401
Fax No. (804) 271-6446



ACCT

SEND
TO:

HATCHER-SAYRE INC
905 SOUTHLAKE BLVD
RICHMOND VA 23236

GROWER:

WESTMORELAND
0957-002

SAMPLES
SUBMITTED
BY:

HATCHER-SAYRE INC

DATE RECEIVED 12/19/00
DATE OF ANALYSIS 12/20/00

DATE OF REPORT 12/22/00 PAGE 1

SOIL ANALYSIS REPORT

SAMPLE IDENT.	LAB NO.	Nitrogen N mg/kg	Phos- phorus P mg/kg	Potassium K mg/kg	Sulfur S mg/kg	Calcium Ca mg/kg	Magnesium Mg mg/kg	Sodium Na mg/kg	Iron Fe mg/kg	Aluminum Al mg/kg	Manganese Mn mg/kg	Copper Cu mg/kg	Zinc Zn mg/kg	Ammonia Nitrogen mg/kg	Nitrate Nitrogen mg/kg
15458	01103	200										5	16		
15459	01104	700										7	29		
15460	01105	400										7	24		
15461	01106	300										7	14		
15462	01107	400										10	24		
LAB NO.	Cadmium Cd mg/kg	Chromium Cr mg/kg	Nickel Ni mg/kg	Lead Pb mg/kg	Arsenic As mg/kg	Mercury Hg mg/kg	Selenium Se mg/kg	Organic Nitrogen mg/kg	pH	Total C.E.C. (meq/100g)					
01103	< 1		6	< 5	1.45	<0.01									
01104	< 1		11	5	1.90	<0.01									
01105	< 1		8	< 5	1.79	<0.01									
01106	< 1		5	5	3.51	<0.01									
01107	< 1		7	5	2.31	<0.01									

REPORT NUMBER:
R355-100

A&L EASTERN AGRICULTURAL LABORATORIES, INC.

7621 Whitepine Road • Richmond, Virginia 23237 • (804) 743-9401
Fax No. (804) 271-6446



SEND
TO:

HATCHER-SAYRE INC
905 SOUTHLAKE BLVD
RICHMOND VA 23236

GROWER:
WESTMORELAND
0957-002

SAMPLES
SUBMITTED
BY:
HATCHER-SAYRE INC

DATE RECEIVED 12/19/00
DATE OF ANALYSIS 12/20/00

SOIL ANALYSIS REPORT

DATE OF REPORT 12/22/00 PAGE 2

SAMPLE IDENT.	LAB NO.	Nitrogen N mg/kg	Phos- phorus P mg/kg	Potassium K mg/kg	Sulfur S mg/kg	Calcium Ca mg/kg	Magnesium Mg mg/kg	Sodium Na mg/kg	Iron Fe mg/kg	Aluminum Al mg/kg	Manganese Mn mg/kg	Copper Cu mg/kg	Zinc Zn mg/kg	Ammonia Nitrogen mg/kg	Nitrate Nitrogen mg/kg
15463	01108	200										5	5		
15464	01109	400										6	14		
15465	01110	200										5	8		
LAB NO.	Cadmium Cd mg/kg	Chromium Cr mg/kg	Nickel Ni mg/kg	Lead Pb mg/kg	Arsenic As mg/kg	Mercury Hg mg/kg	Selenium Se mg/kg	Organic Nitrogen mg/kg	pH	Total C.E.C. (meq/100g)					
01108	< 1		126	< 5	0.77	< 0.01									
01109	< 1		5	6	2.07	< 0.01									
01110	< 1		< 5	< 5	0.94	< 0.01									



HATCHER-SAYRE, INC.

905 SOUTHLAKE BLVD., RICHMOND, VIRGINIA 23236 • (804) 794-0216 • FAX (804) 379-8934 • E-MAIL: hsi@erols.com

CHAIN OF CUSTODY RECORD

PROJECT		ANALYSES REQUIRED		SAMPLE TYPE (CHECK BOX)		NUMBER OF CONTAINERS		PRESERVATION	
PROJECT NO.		COMPOSITE		GRAB		REMARKS OR SAMPLE LOCATION		SPECIFY CHEMICALS	
SAMPLER'S SIGNATURE		DATE		TIME		MATRIX		ICED	
PRINTED NAME		DATE		TIME		MATRIX		ICED	
Westmoreland		12/14/00		12:14:00		Solid		Field A2 (2.0-4.0')	
0957-002		12/14/00		12:14:00		Solid		Field A1 (0.3-2.0')	
Jens G. Foster		12/16/00		12:16:00		Solid		Field B1 (0.1-2.0')	
J. S. Foster		12/16/00		12:16:00		Solid		Field B2 (2.0-4.0')	
HATCHER-SAYRE, INC.		12/16/00		12:16:00		Solid		Field C1 (0.7-2.5')	
SAMPLE NO.		12/16/00		12:16:00		Solid		Field C2 (2.5-5.0')	
15458		12/16/00		12:16:00		Solid		Field D1 (0.2-2.2')	
15459		12/16/00		12:16:00		Solid		Field D2 (2.2-4.5')	
15460		12/16/00		12:16:00		Solid			
15461		12/16/00		12:16:00		Solid			
15462		12/16/00		12:16:00		Solid			
15463		12/16/00		12:16:00		Solid			
15464		12/16/00		12:16:00		Solid			
15465		12/16/00		12:16:00		Solid			
RELINQUISHED BY (SIGNATURE):		DATE		TIME		RELINQUISHED TO (SIGNATURE):		SHIPPING TICKET NO.	
Jens G. Foster		12/19/00		10:30 AM		RELINQUISHED TO (SIGNATURE):		SHIPPING COMPANY	
RELINQUISHED BY (SIGNATURE):		DATE		TIME		RELINQUISHED TO (SIGNATURE):		REMARKS:	
RELINQUISHED BY (SIGNATURE):		DATE		TIME		RELINQUISHED TO (SIGNATURE):		TURNAROUND REQUIRED	
RELINQUISHED BY (SIGNATURE):		DATE		TIME		RELINQUISHED TO (SIGNATURE):		24 HOURS <input type="checkbox"/> 48 HOURS <input type="checkbox"/>	
RELINQUISHED BY (SIGNATURE):		DATE		TIME		RELINQUISHED TO (SIGNATURE):		NORMAL <input checked="" type="checkbox"/> OTHER <input type="checkbox"/>	

Appendix C
Water Budget Analysis

Water Budget Analysis

81,430 gpd received from the WWTP from April through September
49,285 gpd received from the WWTP from October through March

Water Applied from April through September

81,430 gpd x 188 growing days = 15,308,840 gallons

Application Rate of 1 inch/day and 2 inches/week

$15,308,840 \div 27,154 = 563.78$

$563.78 \div 37.8 = 14.9$ inches applied

Water Applied from October through March

49,285 gpd x 177 growing days = 8,723,445 gallons

Application Rate of 1 inch/day and 2 inches/week

$8,723,445 \div 27,154 = 321.26$

$321.26 \div 37.8 = 8.50$ inches applied

14.9 inches (April – September) + 8.5 inches (October – March) = 24 inches applied yearly

Irrigation

Area available for irrigation: 50.4 acres

Amount of irrigation applied per year: 24 acre/inches

50.4 acres x 24 acre/inches applied = 1,210 total irrigation acre/inches applied a year

1,210 acre/inches per year x 27,154 gallons per acre inch = 32,856,340 gallons per year

32,856,340 gallons per year \div 365 days per year = 90,017 gallons per day.

Appendix D

Nutrient Balance Analysis

Nutrient Balance Analysis

WWTP effluent strengths obtained from Resource International:

Total N (assumed)	24.26 mg/L
Organic N	5.0 mg/L
NH ₃	1.0 mg/L
NO ₃	20.0 mg/L
P	4.0 mg/L
K	1.5 mg/L

Plant Available Nitrogen (PAN) received from the WWTP is obtained from the following formula:
[20 ppm (NO₃) x 0.2] + [1.0 ppm (NH₃) x 0.5] x 5.0 ppm (Organic N) = 22.5 ppm

Loading Calculation Formula:
$$\frac{(\text{concentration}) \times (0.08143 \text{ mgd}) \times 8.34 \text{ lb/yr} \times 188 \text{ days}}{50.4 \text{ application acres}}$$

Loading Calculations Formula simplified:

Corn: (concentration) x 2.62

Wheat: (concentration) x 1.458

Calculated Nutrient Loading Rates

PAN: 22.5 ppm x 2.62 = 58.95 lbs/acre/year for corn
22.5 ppm x 1.458 = 32.81 lbs/acre/year for wheat/barley

*There will be a 10% carry-over of 10.7 lbs/acre/year of PAN. A soil and plant tissue sample needs to be collected and submitted to a qualified laboratory to perform nitrogen concentration analysis.

Phosphorous: 4.0 ppm x 2.62 = 10.48 lb/ac/yr as P
10.48 x 2.29 (conversion coefficient) = 24.0 lb/ac/yr P₂O₅ for corn
4.0 ppm x 1.458 = 5.83 lb/ac/yr as P
5.83 x 2.29 (conversion coefficient) = 13.36 lb/ac/yr P₂O₅ for wheat/barley

Potassium: 1.5 ppm x 2.62 = 3.93 lb/ac/yr as K
3.93 x 2.29 (conversion coefficient) = 9.0 lb/ac/yr K₂O for corn
1.5 ppm x 1.458 = 2.19 lb/ac/yr as K
2.19 x 2.29 (conversion coefficient) = 5 lb/ac/yr K₂O for wheat/barley

Residual Plant Nitrogen (RPN) years 2-5:

WWTP organic nitrogen = 5.0 parts per million

Availability coefficient 0.5

Organic Nitrogen: 5 mg/L x 0.50 = 2.5 mg/L
2.50 mg/L x 9.05 = 22.62 mg/L

Residual Factor: 0.20

Amount of Available Nitrogen:

203 lbs/acre of RPN \times 0.35 = 71.33 lbs/acre/year cover additional 85.90 lbs/acre to be supplemental in year 2 on corn, 20% will be residual in soil for plant availability.

Site Soils:

Soil Series	Soil Mgt Group	Productivity Group		
		Corn	Small Grain	Hay
State	B	Ia	I	I
Tetotum	K	IIb	I	I
Lumbee	OO	V	V	N/S

Soil Productivity:

Soil Series	Productivity Group		
	Yield		
	Corn	Wheat/Barley	Fescue
State	160 bu/ac	64 bu/ac	4.0 bu/ac
Tetotum	130 bu/ac	64 bu/ac	4.0 tons/ac
Lumbee	65 bu/ac	24 bu/ac	N/S

Note: Information obtained from Table 1.2 of the Virginia Nutrient Management Standards and Criteria. Nitrogen Recommendations

	Corn	Grain	Hay
State	180 lb/ac/yr	60 lb/ac/yr	40 lb/ac/yr
Tetotum	160-180 lb/ac/yr	60 lb/ac/yr	40 lb/ac/yr
Lumbee	85 lb/ac/yr	40 lb/ac/yr	N/S

County Code 193	Leaching Indexes	Hydrologic Group
State	13	B
Tetotum	6	C
Lumbee	6	D
A = 17 B = 17 C = 6 D = 6		

Appendix E
Site Life Analysis

Site Life Analysis

Nickle:	0.005 mg/L $0.005 \times 5.18 = 0.0259$ lbs/acre/year Site life $44/0.259 = 1,698$ years
Copper:	0.01 mg/L $0.01 \times 5.18 = 0.0518$ lbs/acre/year Site life $111/0.0518 = 2,142$ years
Zinc:	0.1 mg/L $0.1 \times 5.18 = 0.518$ lbs/acre/year Site life $222/0.518 = 428$ years
Lead:	0.02 mg/L $0.02 \times 5.18 = 0.1036$ lbs/acre/year Site life $445/0.1036 = 4,295$ years
Cadmium:	0.002 mg/L $0.002 \times 5.18 = 0.01036$ lbs/acre/year Site life $2.22/0.01036 = 214$ years
Boron:	1.0 mg/L $1.0 \times 5.18 = 905$ lbs/acre/year

Boron is essential for plant growth and is required for most plants. Available data indicates that corn removes 0.5 - 1.0 lbs of boron per acre/year. Available information also indicates that acceptable levels of boron in leachate are 0.75 to 2.0 mg/L. Concentrations of 1.0 mg/L are rational.

Maximum application rate allowable: 2 inches/week and 1 inch/day and ¼ inch/hour

Soil saturation will be measured by installation of tensiometers to determine soil moisture prior to irrigation of dry field. Tensiometers read centibars of tension. When reading are < 10 centibars- do not irrigate. When >20 centibars irrigate until approximately 10 centibars level, but not more than 1 inch/day.

Fields should not be irrigated five to six days prior to harvesting crops.

Appendix F
Application Schedule

TABLE 2
CLIMATIC DATA & APPLICATION LOADING RATES

Month	Evapotranspiration Rates ¹	Precipitation Rates ² inches per month	Percolation Rate inches per day	Loading Rates inches per month
January	0.71	3.10	24	21.61
February	0.85	2.96	24	21.89
March	1.62	3.70	24	21.92
April	2.72	2.80	24	23.92
May	3.7	3.93	24	23.27
June	4.53	3.45	24	25.08
July	4.72	4.74	24	23.98
August	4.27	4.99	24	23.78
September	4.19	3.64	24	24.55
October	3.09	2.64	24	24.45
November	1.94	3.04	24	22.90
December	0.88	3.23	24	21.65
Total	33.22	42.22	288	279

Notes:

1) Completed using the Blaney-Criddle Method, Soil and Water Conservation Engineering, Schwab, Frevert, Edminster, and Barnes, Second Edition. January 1966.

2) Mean monthly precepitation rates obtained from NOAA for Urbanna, Virginia.

Yearly Summary

Month	Gallons of Effluent		
	Field A	Field B	Total
April	741,300	2,851,130	3,592,430
May	635,400	2,443,840	3,079,240
June	847,200	3,258,480	4,105,680
July	847,200	3,665,790	4,512,990
August	635,400	2,443,860	3,079,260
September	317,700	1,323,767	1,641,467
October	529,500	1,629,220	2,158,720
November	529,500	2,036,550	2,566,050
December	42,500		42,500
January	40,826		40,826
February	38,982		38,982
March	48,227		48,227
Grand Totals:	5,253,735	19,652,637	24,906,372

July						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 Spray Field A with 1/2" of effluent (105,900 gallons)	2 Spray Field B with 1/2" of effluent (407,310 gallons)	3 Rest	4 Spray Field A with 1/2" of effluent (105,900 gallons)	5 Rest
6	7 Rest	8 Rest	9 Spray Field A with 1" of effluent (211,800 gallons)	10 Spray Field B with 1" of effluent (814,620 gallons)	11 Rest	12 Spray Field A with 1" of effluent (211,800 gallons)
13	14 Rest	15 Spray Field B with 1" of effluent (814,620 gallons)	16 Rest	17 Spray Field A with 1" of effluent (211,800 gallons)	18 Spray Field B with 1" of effluent (814,620 gallons)	19 Rest
20	21 Rest	22 Rest	23 Rest	24 Rest	25 Rest	26 Rest
27	28 Spray Field B with 1" of effluent (814,620 gallons)	29 Rest	30 Rest	31 Rest		

Total Monthly Applied	
Field A: 4"	847,200 gallons
Field B: 4 1/2"	3,665,790 gallons
Total	4,512,990 gallons

August						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
					Spray Field A with 1/2" of effluent (105,900 gallons)	Rest
3	4	5	6	7	8	9
Rest	Spray Field B with 1/2" of effluent (407,310 gallons)	Rest	Rest	Spray Field A with 1/2" of effluent (105,900 gallons)	Rest	Rest
10	11	12	13	14	15	16
Spray Field B with 1/2" of effluent (407,310 gallons)	Rest	Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)	Rest	Rest	Rest
17	18	19	20	21	22	23
Rest	Rest	Rest	Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)	Rest	Spray Field A with 1" of effluent (211,800 gallons)
24/31	25	26	27	28	29	30
Rest	Rest	Rest	Spray Field B with 1" of effluent (814,620 gallons)	Rest		Rest

Total Monthly Applied

Field A: 3"	635,400 gallons
Field B: 3"	2,443,860 gallons
Total	3,079,260 gallons

September						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1 Spray Field A with 1/2" of effluent (105,900 gallons)	2 Spray Field B with 1/2" of effluent (407,310 gallons)	3 Rest	4 Spray Field A with 1/4" of effluent (52,950 gallons)	5 Spray Field B with 1/4" of effluent (203,655 gallons)	6 Rest
7	8	9	10	11	12	13
Rest	Rest	Rest	Spray Field A with 1/4" of effluent (52,950 gallons)	Rest	Spray Field B with 3/8" of effluent (305,492 gallons)	Rest
14	15	16	17	18	19	20
Rest	Rest	Rest	Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)	Rest	Rest
21	22	23	24	25	26	27
Rest	Rest	Rest	Rest	Rest	Rest	Rest
28	29	30				
Rest	Rest	Rest				

Total Monthly Applied

Field A: 1 1/2 " 317,700 gallons
Field B: 1 5/8 " 1,323,767 gallons
Total 1,641,467 gallons

October						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
			Rest	Rest	Rest	Rest
5	6	7	8	9	10	11
Rest	Pick Corn	Pick Corn	Pick Corn	Pick Corn	Rest	Rest
12	13	14	15	16	17	18
Rest	Rest	Rest	Plant Wheat	Plant Wheat	Rest	Rest
19	20	21	22	23	24	25
Rest	Rest	Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)	Rest	Rest	Spray Field A with 1" of effluent (211,800 gallons)
26	27	28	29	30	31	
Spray Field B with 1" of effluent (814,600 gallons)	Rest	Rest	Rest	Spray Field A with 1" of effluent (211,800 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)	

Total Monthly Applied

Field A: 2 1/2" 529,500 gallons
Field B: 2 1/2" 1,629,220 gallons
Total 2,158,720 gallons

November						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
2	3	4	5	6	7	1/8
				Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)	
9	10	11	12	13	14	15
			Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)		
16	17	18	19	20	21	22
	Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)				Spray Field A with 1/2" of effluent (105,900 gallons)
23	24	25	26	27	28	29
Spray Field B with 1/2" of effluent (407,310 gallons)			Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)		
30						

Total Monthly Applied

Field A: 2 1/2"	529,500 gallons
Field B: 2 1/2"	2,036,550 gallons
Total	2,566,050 gallons

December						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3 Spray Field A with .18" of effluent if above 42°F and soil are not saturated (42,500 gallons)	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Total Monthly Applied

Field A: 0.18"

42,500 gallons

Total 42,500 gallons

January						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5	6	7	8	9	10	11
			Spray Field A with .17" of effluent if above 42°F and soil are not saturated (40,826 gallons)			
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Total Monthly Applied

Field A: 0.17"

40,826 gallons

Total 40,826 gallons

February						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
			Spray Field A with .004" of effluent if above 42°F and soil are not saturated (38,982 gallons) *			
16	17	18	19	20	21	22
23	24	25	26	27	28	

* Run irrigation
system - nitrates

Total Monthly Applied
Field A: .004" 38,982 gallons

Total 38,982 gallons

March						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
2	3	4	5	6	7	1/8
9	10	11	12	13	14	15
			Spray Field A with .22" of effluent if above 42°F and soil are not saturated (48,227 gallons)			
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Total Monthly Applied
Field A: 0.22" 48,227 gallons

Total 48,227 gallons

June						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
Rest	Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)	Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)	Rest	Rest
8	9	10	11	12	13	14
Rest	Spray Field A with 1" of effluent (211,800 gallons)	Spray Field B with 1" of effluent (814,620 gallons)	Rest	Spray Field A with 1" of effluent (211,800 gallons)	Spray Field B with 1" of effluent (814,620 gallons)	Rest
15	16	17	18	19	20	21
Rest	Rest	Rest	Spray Field A with 1" of effluent (211,800 gallons)	Spray Field B with 1" of effluent (814,620 gallons)	Rest	Rest
22	23	24	25	26	27	28
Rest	Rest	Rest	Rest	Rest	Rest	Rest
29	30					
Rest	Rest					

Total Monthly Applied

Field A: 4"	847,200 gallons
Field B: 4"	3,258,480 gallons
Total	4,105,680 gallons

May						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2	3
				Rest	Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)
4	5	6	7	8	9	10
Rest	Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)	Test soil for nitrate application	Rest	Rest	Rest
11	12	13	14	15	16	17
Rest	Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)	Rest	Rest	Rest	Field A: Side dress phosphorus and potassium 85 lbs/acre. Supplement nitrates only if 5/7 nitrate soils test indicate need.
18	19	20	21	22	23	24
Spray Field A with 1/2" of effluent (105,900 gallons)	Spray Field B with 1/2" of effluent (407,310 gallons)	Rest	Rest	Rest	Spray Field A with 1" of effluent (211,800 gallons)	Spray Field B with 1" of effluent (814,600 gallons)
25	26	27	28	29	30	31
Rest	Rest	Rest	Rest	Rest	Rest	Rest

Total Monthly Applied

Field A: 3"	635,400 gallons
Field B: 3"	2,443,840 gallons
Total	3,079,240 gallons

April						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	March 30	1	2	3	4	5
	Plant corn and apply starter fertilizer at 30 lbs/acre of nitrogen	Spray Field B with 1/4" of effluent (203,655 gallons)	Rest	Spray Field A with 1/4" of effluent (52,950 gallons)	Rest	Rest
6	7	8	9	10	11	12
	Spray Field B with 1/4" of effluent (203,655 gallons)	Rest	Spray Field A with 1/4" of effluent (52,950 gallons)	Rest	Rest	Rest
13	14	15	16	17	18	19
Spray Field B with 1/2" of effluent (407,310 gallons)	Rest	Spray Field A with 1/2" of effluent (105,900 gallons)	Rest	Rest	Spray Field B with 1/2" of effluent (407,310 gallons)	Rest
20	21	22	23	24	25	26
Rest	Spray Field A with 1/2" of effluent (105,900 gallons)	Rest	Spray Field B with 1" of effluent (814,600 gallons)	Rest	Spray Field A with 1" of effluent (211,800 gallons)	Rest
27	28	29	30			
Spray Field B with 1" of effluent (814,600 gallons)	Spray Field A with 1" of effluent (211,800 gallons)	Rest	Rest			

Total Monthly Applied	
Field A: 3 1/2"	741,300 gallons
Field B: 3 1/2"	2,851,130 gallons
Total	3,592,430 gallons

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JAN 07 2008
PRO

VPA01423
R-G-R+

January 4, 2008

P.N. 94024.03

Ms. Denise Mosca
Virginia Department of Environmental Quality
Piedmont Regional Office
4949 A Cox Road
Glen Allen, VA 23060

**RE: Wastewater Collection and Treatment System – Update Site Life Projections
VPA Permit VPA01423 - Coles Point
Westmoreland County, Virginia**

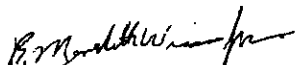
Dear Ms. Mosca:

In response to your request, and according to the above-referenced permit paragraph 28, Resource International, Ltd., has prepared the enclosed update on "site life projections." In the original permit application, assumed values were used for this projection. This table has now been updated using actual metals concentrations from testing in 2007.

It should be noted that all metals except zinc were below detection limits (BDL), so the detection limit was used in the calculation. The actual concentrations may have been much less, therefore the site life projections should be considered very conservative.

We look forward to your review of these responses. If you have any questions, feel free to contact me at the above referenced number.

Sincerely,



B. Meredith Winn, Jr., P.E.
Senior Process Engineer

/sbd

cc: Mr. Norm Risavi, Westmoreland County
Mr. Gary France, Westmoreland County

APPENDIX E
[Revised with 2007 Data]

SITE LIFE PROJECTIONS

Site life is calculated by projecting the accumulation of certain elements in the soil until such time as they reach an imposed limit. In order to be conservative, these calculations do not take into account any loss from the soil due to leaching or crop uptake. With the exception of zinc, the tests results showed concentrations less than detectible limits. For the calculations, the detection limit was used as the actual value. For purposes of the calculation it is assumed that all of the metals are captured in the top 12 inches of soil.

Element	Concentration in Effluent*	Concentration Limit in Soil**
	Mg/L	Lb/Ac-ft
Nickel	<0.020	44
Copper	<0.020	111
Zinc	0.102	222
Lead	<0.005	445
Cadmium	<0.010	2.22

* From testing done in 2007 by Primary Labs.

** Limits from: "Soil Fertility and Fertilizer" Tisdale & Nelson, 1982, MacMillan & Co. pp. 343-344; "Micro-nutrients Status and Needs of the Southern Region" Plant Food Review, 1961-64; and Soil Chemistry of Hazardous Materials, James Dragun, Hazardous Materials Control Resources Institute, 1988, pp. 75-195

Assume: 20 inches of irrigation applied per year.

Assume: Existing concentrations of elements are minimal (see soil analyses).

$$(\text{Mg/L}) \times 0.000062428 = \text{lb/cu ft}$$

$$\text{cu ft irrigation /ac-yr} = 43560 \text{ sq ft} \times (20/12) = 72,600 \text{ cu ft/ac}$$

$$\text{Lb/ac-yr} = (\text{lb/cu ft}) \times (\text{cu ft/ac})$$

For Nickel:

$$\text{Lb/ac-yr} = 0.020 \times 0.000062428 \times 72,600 = 0.091 \text{ Lb/ac-yr}$$

$$\text{Site Life} = \text{Conc limit/Lb/ac-yr} = 44 \div 0.091 = \underline{485 \text{ yrs}}$$

For Copper:

$$\text{Lb/ac-yr} = 0.020 \times 0.000062428 \times 72,600 = 0.091 \text{ Lb/ac-yr}$$

$$\text{Site Life} = \text{Conc limit/Lb/ac-yr} = 111 \div 0.08 = \underline{1224 \text{ yrs}}$$

For Zinc:

$$\text{Lb/ac-yr} = 0.102 \times 0.000062428 \times 72,600 = 0.46 \text{ Lb/ac-yr}$$

$$\text{Site Life} = \text{Conc limit/Lb/ac-yr} = 222 \div 0.46 = \underline{480 \text{ yrs}}$$

For Lead:

$$\text{Lb/ac-yr} = 0.005 \times 0.000062428 \times 72,600 = 0.023 \text{ Lb/ac-yr}$$

$$\text{Site Life} = \text{Conc limit/Lb/ac-yr} = 445 \div 0.023 = \underline{19637 \text{ yrs}}$$

For Cadmium:

$$\text{Lb/ac-yr} = 0.010 \times 0.000062428 \times 72,600 = 0.045 \text{ Lb/ac-yr}$$

$$\text{Site Life} = \text{Conc limit/Lb/ac-yr} = 2.22 \div 0.045 = \underline{49 \text{ yrs}}$$

Conclusion:

At full allowed capacity, the minimum site life is 49 years.

[Note: Site life projections are worst case, and would be extended if actual Cd concentration is less, and if less than 20 inches of irrigation are used.]